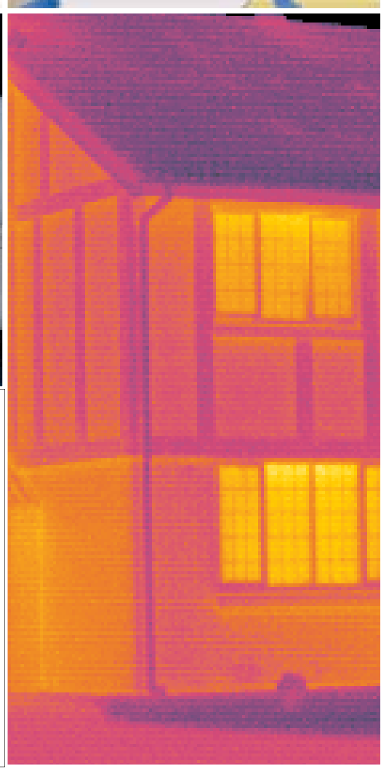
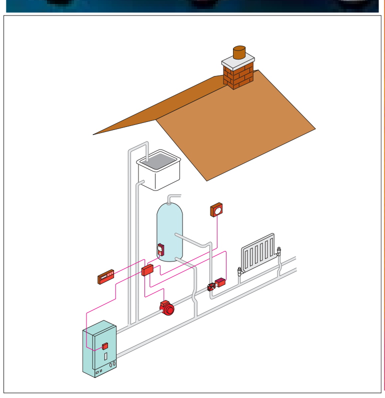
GOOD PRACTICE GUIDE 171

Domestic Energy Efficiency Primer



A guide for energy advisers, installers and suppliers

- **Become familiar with energy efficiency without being an expert**
- **Advise customers who wish to reduce their fuel bills**
- **Identify opportunities for improving energy efficiency during other work**
- **Recommend energy efficient solutions to building problems**

GOOD PRACTICE GUIDE 171

2003 edition

HOUSING ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

About this Guide

ABOUT THIS GUIDE

This Guide has been produced as part of the Government's Housing Energy Efficiency Best Practice Programme (HEEBPp), in partnership with the Energy Saving Trust's Energy Efficiency initiative. The Guide is available to all installers, retailers, local authorities, housing associations and other advisers under the HEEBPp; further copies are available from the HEEBPp Helpline on 01923 664258.

Energy Efficiency is a Government backed marketing initiative implemented by the Energy Saving Trust (EST). Launched in 1997, its remit is to encourage consumers to buy the most energy efficient products and services for their homes, with the ultimate aim of reducing carbon dioxide emissions in the UK.

For details contact the Energy Saving Trust 21 Dartmouth Street, London SW1H 9BP, telephone 0845 727 7200.

Credits

This Guide is based on a concept developed by Projects in Partnership in collaboration with the HEEBPp, the Energy Saving Trust, The London Borough of Camden and Kirklees District Council. It has been developed in consultation with installers, trade organisations, builders' merchants, national home improvement/DIY retailers, local energy staff and Energy Efficiency Advice Centres.

The Guide was first published in 1996 and revised in 2002.

BEST PRACTICE PROGRAMME

HOUSING ENERGY EFFICIENCY

ENERGY EFFICIENCY™

SAVE ENERGY MONEY ENVIRONMENT

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THE PURPOSE OF THIS GUIDE

This Guide is designed to help you with enquiries from clients about either home improvements or building problems. In the case of home improvements, measures to improve energy efficiency are often cheaper if they are installed when other building work is carried out. Where there are building problems there is often an opportunity to use energy efficient solutions in order to provide the added benefit of reducing the client's fuel bills and improving comfort.

This Guide is for:

Housing energy advisers

- local authorities and housing association managers
- environmental health officers
- building control officers
- property services managers
- staff of energy advice centres

Building materials suppliers

- staff at DIY stores
- counter staff at trade wholesalers

Trade professionals

- plumbers
- heating installers
- insulation installers
- builders
- electricians

HOW THIS GUIDE IS ARRANGED

A Opportunities (pages 4-5)

This section of the Guide summarises the opportunities for improving energy efficiency that should be considered when other building improvements or repairs are being made.

B Cost Effectiveness (pages 6-9)

This section provides a guide to the relative cost-effectiveness of energy efficiency measures when they are installed in a range of typical dwellings. Measures are ranked for high, medium or low cost-effectiveness.

'Cost benefits' tables are given for a range of dwellings on a separate leaflet at the back of this document. Updates to this leaflet can be found on the HEEBPp website at www.housingenergy.org.uk
The leaflet will be updated regularly.

C Improvement Measures (pages 10-36)

This section describes each type of energy efficiency measure, offers basic guidance and points to watch, and includes references to more detailed guidance.

D Grants, Assistance (page 37) and Publications (back page)

This section lists key grant sources and useful contacts for further information and assistance.

Cost Benefits Tables (inside pocket of back cover)

Using this Guide with clients

Decide with the client whether the proposed work is home improvement **or rectification of a** building problem

Home improvement

A1

Identify opportunities to improve energy efficiency from Section A1: Opportunities, on page 4

Building problem

A2

Identify opportunities to improve energy efficiency from Section A2: Opportunities, on page 5

Cost effectiveness

B

Compare the cost effectiveness of selected opportunities in Section B: Cost Effectiveness, on pages 6-9 and Cost Benefits table (leaflet) at the back of this document

Measures

C

Find key information about improvements in Section C: Measures, on pages 10-36

Grants, Assistance

D

Look in Section D: Grants and Assistance on page 37 for useful information about grants and further advice

A1
Home improvement
page 4

A2
Building problems
page 5

B
Cost effectiveness
pages 6-9
Cost benefits leaflet

C
Measures
pages 10-36

D
Grants and Assistance
page 37

A1

OPPORTUNITIES ASSOCIATED WITH HOME IMPROVEMENTS

Energy efficiency measures	Wall insulation	Roof insulation	Floor insulation	Efficient heating and controls	Efficient hot water system	Draught-stripping	Ventilation	Windows	Energy efficient lighting	Energy efficient appliances	Check if Building Regs apply*
Details on page	10	14	18	19, 22	24	26	27	30	31	32	
Moving into an 'existing' new home	○	○	○	○	○	○	○	○	●	●	
Extension	●	●	●	○	○	●	●	●	●	●	✓
Loft conversion	●	●		○	○	●	●	●	●		✓
Nursery	○	○	○	○	○	○	○	○	●		
New kitchen	○		○			○	●	○	●	●	
New bathroom	○	○	○			○	●	○	●		
New heating system	●	●	●	●	●	●	●	●			✓
Adding a conservatory				○	○	○	●	●	●		✓
Re-roofing	○	●					○				✓
Replacing windows	○					●	●	●			✓
Re-wiring	○	○	○						●	○	✓
Re-flooring			●								✓
Replacing boiler	○	○	○	●	●	○	○	○			✓
Replacing hot water cylinder				○	●						✓
Decorating	○					●			○		
Re-rendering externally	●							○			✓

IMPORTANT NOTES

- All energy efficiency measures may be worth considering.
- Some home improvements are subject to statutory regulations which set minimum standards.

Using this Chart

If your client is planning a home improvement measure, look at the left-hand column and find the job most like the one your client requires. Then read across the chart to see which energy efficiency measures could be carried out at the same time. Make a note of the possible opportunities and refer to the pages identified at the top of the chart for more information.

Boxes marked ● indicate good opportunities for cost-effective energy efficiency improvements.

Boxes marked ○ indicate other opportunities that are well worth considering.

***Note:** This column is only a guide. Different regulations may apply under Building Regulations Part L1 (England and Wales), Building Standards Part J (Scotland) and Building Regulations Part F (Northern Ireland). Contact the Building Control Officer in the local authority for more information. Other building works and improvements may also attract the requirements of the building regulations. For example, in Scotland altering the ventilation arrangements may require approval.

Opportunities

A2

OPPORTUNITIES ASSOCIATED WITH BUILDING PROBLEMS

Energy efficiency measures	Wall insulation	Roof insulation	Floor insulation	Efficient heating and controls	Efficient hot water system	Draught-stripping	Ventilation	WIndows	Energy efficient lighting	Energy efficient appliances	Check if Building Regs apply*
Details on page	10	14	18	19/22	24	26	27	30	31	32	
High fuel bills	●	●	●	●	●	○	○	○	●	●	✓
Inadequate heating	○	○	○	●	●	○	○	○			✓
Insufficient hot water				●	●						✓
Cold rooms	●	●	●	●		●	○	○			✓
Draughty rooms						●	○	○			
Stuffy rooms				○			●				
Musty rooms	●	○	○	○		○	●				✓
Condensation	●	●	○	○		○	●	○			✓
Penetrating or rising damp	○		○								
Burst pipe or leak				○	○						
Wet or dry rot	○	○	○			○	○				
Rotted window frames						●	○	●			✓
External noise penetration						●	○	●			✓

Using this Chart

If your client has a building problem, look at the left-hand column and find the problem most like the one your client has reported. Then read across the chart to see which energy efficiency measures could be carried out at the same time. Make a note of the possible opportunities and refer to the pages identified at the top of the chart for more information.

Boxes marked ● indicate good opportunities for cost-effective energy efficiency improvements.

Boxes marked ○ indicate other opportunities that are well worth considering.

General references

(applicable to energy efficient home improvement and dealing with building problems)

- GPG 155: *Energy efficient refurbishment of existing housing*
- GIL 59: *Central Heating Systems Specifications (CHeSS)*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

***Note:** This column is only a guide. Different regulations may apply under Building Regulations Part L1 (England and Wales), Building Standards Part J (Scotland) and Building Regulations Part F (Northern Ireland). Contact the Building Control Officer in the local authority for more information. Other building works and improvements may also attract the requirements of the building regulations. For example, in Scotland altering the ventilation arrangements may require approval.

B

DWELLING TYPES

Use these pictures to decide which dwelling type is most like your client's home. Then refer to pages 7-9 of this Guide and the leaflet (GPG 171CE) containing the 'cost benefits' tables in the pocket at the back of this guide.

Detached house p7

Bungalow p7

Semi-detached house p7

End-of-terrace house p7

Mid-terraced house p8

Flat p9

DETACHED, SEMI-DETACHED, END-OF-TERRACE HOUSES AND BUNGALOWS

Use this chart to establish the range of capital cost and overall cost-effectiveness of possible improvement measures.

● Indicates energy efficiency measures that are usually highly cost-effective; the cost of installation should be recovered via reduced fuel bills in 5 years or less.

❍ Indicates energy efficiency measures that are usually cost-effective; the cost of installation should be recovered via reduced fuel bills in between 5 and 10 years.

❑ Indicates effective energy measures for which the time taken to recover the cost of installation may exceed 10 years.

Below is a list of low-, medium- and high-cost measures. Measures marked * are classified according to their *marginal* costs, ie the extra cost of upgrading the energy efficiency of the installation when a component or system is to be replaced anyway.

	LOW-COST MEASURES	SEE PAGE
●	Loft insulation (DIY)	15
●	Floor insulation (DIY)	18
●	Hot water cylinder insulation (including primary pipework insulation – between boiler and tank)	24, 25
●	Draught-stripping (DIY)	26
●	Energy efficient lighting (plug-in lamps in existing internal or external fittings)	31

	MEDIUM-COST MEASURES	
●	Cavity wall insulation	11
●	Loft insulation (installed by contractor)	15, 16
❍	Floor insulation (installed by contractor)*	18
●	Upgrade heating controls	20, 21
●	Gas or oil fired high efficiency or condensing regular or combination boiler *	19, 20
❍	Draught-stripping and sealing (by contractor)	26
❑	Ventilation (extract fans or heat recovery room ventilators)	27, 28
❍	Secondary glazing (DIY)	30
❍	Double glazing (low emissivity glass with or without gas fill)*	30
❍	Triple glazing*	30
❍	Energy efficient lighting (internal or external lamps in new fittings)	31

	HIGH-COST MEASURES	
❍	Solid wall insulation (external* or internal by contractor)	12, 13
●	Solid wall insulation (internal DIY)	13
❍	Gas-fired room heaters (replacing central heating in well-insulated dwellings)	22, 23
❑	Ventilation (whole-house mechanical ventilation with heat recovery)	28
❑	Solar water heating (or pre-heating)	33, 34
❑	Roof-mounted photovoltaic cells (PVs) to generate electricity	34

MID-TERRACE HOUSES

Use this chart to establish the range of capital cost and overall cost-effectiveness of possible improvement measures.

- ● Indicates energy efficiency measures that are usually highly cost-effective; the cost of installation should be recovered via reduced fuel bills in 5 years or less.
- ❍ Indicates energy efficiency measures that are usually cost-effective; the cost of installation should be recovered via reduced fuel bills in between 5 and 10 years.
- ❑ Indicates effective energy measures for which the time taken to recover the cost of installation may exceed 10 years.

Below is a list of low-, medium- and high-cost measures. Measures marked * are classified according to their *marginal* costs, ie the extra cost of upgrading the energy efficiency of the installation when a component or system is to be replaced anyway.

	LOW-COST MEASURES	SEE PAGE
●	Loft insulation (DIY)	15
●	Floor insulation (DIY)	18
●	Hot water cylinder insulation (including primary pipework insulation – between boiler and tank)	24, 25
●	Draught-stripping (DIY)	26
●	Energy efficient lighting (plug-in lamps in existing internal or external fittings)	31

	MEDIUM-COST MEASURES	
●	Cavity wall insulation	11
●	Loft insulation (installed by contractor)	15, 16
❍	Floor insulation (installed by contractor)*	18
●	Upgrade heating controls	20, 21
●	Gas or oil fired high efficiency or condensing regular or combination boiler *	19, 20
❍	Draught-stripping and sealing (by contractor)	26
❑	Ventilation (extract fans or heat recovery room ventilators)	27, 28
❍	Secondary glazing (DIY)	30
❍	Double glazing (low emissivity glass with or without gas fill)*	30
❍	Triple glazing*	30
❍	Energy efficient lighting (internal or external lamps in new fittings)	31

	HIGH-COST MEASURES	
❍	Solid wall insulation (external* or internal by contractor)	12, 13
❍	Solid wall insulation (internal DIY)	13
●	Gas-fired room heaters (replacing central heating in well-insulated dwellings)	22, 23
❑	Ventilation (whole-house mechanical ventilation with heat recovery)	28
❑	Solar water heating (or pre-heating)	33, 34
❑	Roof-mounted photovoltaic cells (PVs) to generate electricity	34

FLATS

Use this chart to establish the range of capital cost and overall cost-effectiveness of possible improvement measures.

- ● Indicates energy efficiency measures that are usually highly cost-effective; the cost of installation should be recovered via reduced fuel bills in 5 years or less.
- ❍ Indicates energy efficiency measures that are usually cost-effective; the cost of installation should be recovered via reduced fuel bills in between 5 and 10 years.
- ❑ Indicates effective energy measures for which the time taken to recover the cost of installation may exceed 10 years.

Below is a list of low-, medium- and high-cost measures. Measures marked * are classified according to their *marginal* costs, ie the extra cost of upgrading the energy efficiency of the installation when a component or system is to be replaced anyway.

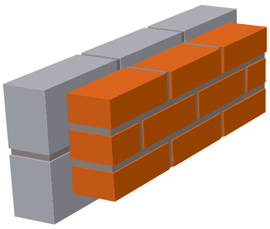
	LOW-COST MEASURES	SEE PAGE
●	Loft insulation (DIY – top floor only)	15
●	Floor insulation (DIY – ground floor only)	18
●	Hot water cylinder insulation (including primary pipework insulation – between boiler and tank)	24, 25
●	Draught-stripping (DIY)	26
●	Energy efficient lighting (plug-in lamps in existing internal or external fittings)	31

	MEDIUM-COST MEASURES	
●	Loft insulation (installed by contractor – top floor only)	15, 16
❍	Floor insulation (installed by contractor – ground floor only)*	18
●	Upgrade heating controls	20, 21
●	Gas or oil fired high efficiency or condensing regular or combination boiler *	19, 20
●	Gas-fired room heater (replacing central heating in well-insulated flat)	22, 23
❍	Draught-stripping and sealing (by contractor)	26
❑	Ventilation (extract fans or heat recovery room ventilators)	27, 28
❍	Secondary glazing (DIY)	30
❍	Double glazing (low emissivity glass with or without gas fill)*	30
❍	Triple glazing*	30

	HIGH-COST MEASURES	
❍	Solid wall insulation (internal by contractor)	13
●	Solid wall insulation (internal DIY)	13
❑	Ventilation (whole-house mechanical ventilation with heat recovery)	28

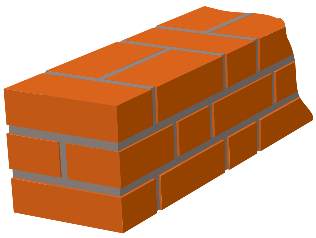
INTRODUCTION

HOW TO IDENTIFY A CAVITY WALL



Cavity walls are usually built of brickwork (for the outer leaf) and concrete blockwork (for the inner leaf). A brick cavity wall usually has all the bricks placed lengthways, and a total thickness of about 300 mm. Most houses built since the 1930s have cavity walls

HOW TO IDENTIFY A SOLID WALL



Solid walls are mainly built of brick or stone. Some solid brick walls can be recognised by the pattern of brickwork: the bricks are placed both head-on and lengthways. The total thickness of the wall is usually about 225 mm. Most pre-1930 houses have solid walls.

Effectiveness

- Most of the heat lost from a typical two-storey detached house is through the external walls. Wall insulation can reduce heat loss through the walls by up to 40% for cavity fill, 60% for solid wall. Wall insulation is therefore one of the first measures that should be considered; the opportunities and costs depend on the type of wall (see below).

- Wall insulation should always be installed before or at the same time as any new heating system is installed, because the reduced heat loss makes it possible to install a smaller and cheaper heating system. If insulation is installed after the heating system is replaced, the boiler will be over-sized and may consequently be less efficient and more expensive to run.

- When combined with roof insulation, adequate heating and controlled ventilation, wall insulation is effective in preventing surface condensation and mould growth.

Types of wall

There are three main types of external wall: cavity masonry walls; solid masonry walls; and timber-framed walls

Most timber-framed walls are already well-insulated and should need little or no extra insulation. Cavity masonry and solid masonry walls should be insulated whenever possible. Cavity walls are easier and cheaper to insulate than solid walls.

Conservatories

If a conservatory is being added to a house, the existing wall(s), windows and doors separating the conservatory from the house should be retained (see below). The separating walls should be insulated, if possible, as if they were external walls. If the openings (ie windows and doors) in the separating walls are enlarged, they must be double-glazed and draught-stripped.

The building regulations

Building Regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

References

- GPG 26: *Cavity wall insulation in existing housing*
- GPG 155: *Energy efficient refurbishment of existing housing*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

REQUIREMENTS FOR SCOTLAND

It is mandatory that a door separates the dwelling from the conservatory.

CAVITY WALL INSULATION

Introduction

Most cavity walls, especially those built after 1930, can be filled. The work usually takes less than half a day; it can be done at any time and the occupants may stay in the house during the installation (although the work is noisy).

The suitability of a wall for filling depends on the exposure of the wall to driving rain, the masonry materials used, the pointing of the masonry outer leaf and the type of insulation material (see GPG 26 for further details, including a map and definition of exposure zones). Timber-framed walls are generally well insulated and must not be cavity filled.

Concrete lintels and cills that extend across the cavity (thermal bridges) may need to be insulated internally to avoid the risk of internal surface condensation (see GPG 26).

Materials

The three most common types of cavity wall insulation for use in existing dwellings are:

- Blown mineral fibre
- Polystyrene (EPS) beads or granules
- Urea formaldehyde (UF) foam

Blown mineral fibre consists of strands of fibreglass or mineral wool that are injected into the cavity using compressed air. This material can be used in any part of the country, and is covered by British Board of Agrément (BBA) certificates (contact details at the back of this document).

Polystyrene beads may be supplied loose, or in a light, sticky resin to hold them together. Polystyrene granules stick together without resin by virtue of their rough shapes. Both types of material are blown into the cavity, and are covered by British Board of Agrément (BBA) certificates.

Urea formaldehyde foam is created within the wall cavity by injecting and simultaneously mixing two chemical components; the foam expands and fills the cavity. This type of insulation is covered by British Standards BS: 5618 for the material and BS: 5617 for its application. There are some concerns about the health effects of formaldehyde following installation of urea formaldehyde cavity wall insulation. Allergic skin reaction to formaldehyde is unlikely at the concentrations used for cavity fill. However, some individuals may suffer irritation to the eyes or upper respiratory tract. If in doubt seek medical advice.

Pre-installation inspection

It is essential that walls are inspected prior to the installation of insulation to assess their suitability. All defects and dampness penetration problems should be identified and corrected before the work begins. If the cavity contains PVC covered electrical cables it should not be insulated until the cables have been removed. Walls with cavities less than 50 mm wide are not recommended for filling.

Installation

Installation of cavity wall insulation must be carried out by a specialist contractor. The contractor should always provide a Cavity Insulation Guarantee Agency (CIGA) guarantee (contact details on page 37); this is the industry-wide guarantee scheme for work of this sort. The insulating material is blown or injected into the wall cavities usually through small holes drilled through the mortar between the brick courses of the outer leaf, usually at about 1-metre spacing. The holes are subsequently filled with matching mortar and quickly become almost invisible. If the wall is to be re-plastered internally an alternative method is to inject the insulation from the inside, before re-plastering.

References

- GPG 26: *Cavity wall insulation in existing buildings*
- GPG 155: *Energy efficient refurbishment of existing housing*
- GIL 23: *Cavity wall insulation: unlocking the potential in existing buildings*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

C

SOLID WALL INSULATION – EXTERNAL

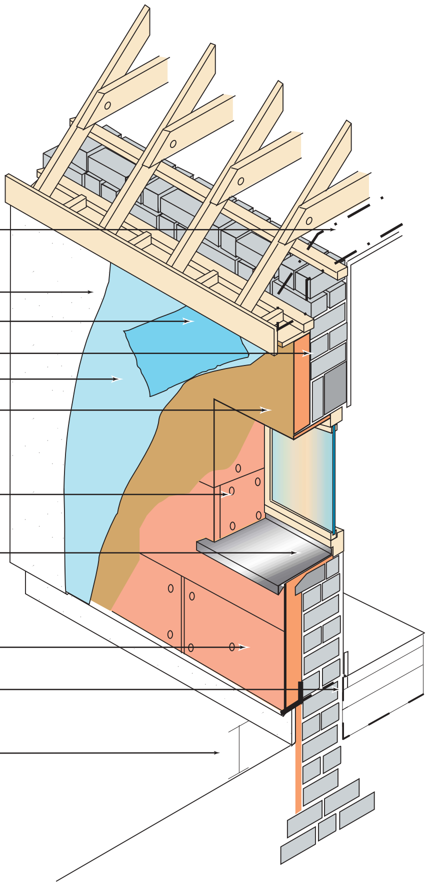
The building regulations

Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

Introduction

External solid wall insulation is worth considering if the exterior walls of the dwelling are in need of repair or if major internal renovation is planned. External insulation can be installed while the occupants remain in the dwelling. However, this form of insulation will have a long payback period if it is not installed in conjunction with other remedial work to the wall.

External wall insulation 'wraps' the masonry walls of the dwelling within the insulation, so rooms will cool down more slowly after the insulation is installed than before; therefore it is most suited to dwellings that are heated all day, rather than those that are heated intermittently. External wall insulation can also alleviate damp penetration.



**** Note: Thermal bridging will occur where levels of insulation vary creating a cold 'bridge' through the insulation.***

Materials and installation

External wall insulation is usually installed as a composite system consisting of insulation material protected by render, cladding or hung tiles. Proprietary systems with British Board of Agrément certificates are recommended. The External Wall Insulation Association (EWIA) (see page 37) maintains a register of proven systems and installers. If a proprietary system is used the work must be carried out by a specialist contractor, but local architect-designed systems can be installed by good general builders.

The overall thickness of the insulation and render or cladding is quite substantial, so care is needed at window cills, rainwater down-pipes and where the walls meet the roof. Specialist installers have techniques for dealing with these problems. Some finishes may be vulnerable to impact damage and require protection or reinforcement near ground level.

Planning considerations

Some finishes (eg render over original brickwork) may need planning permission from the local authority, and additional restrictions may apply in conservation areas, and to buildings listed as of special architectural or historic interest. It is advisable to check with the local planning authority before proceeding with any work.

C

SOLID WALL INSULATION – INTERNAL

Introduction

Internal wall insulation consists of insulating material behind a layer of plasterboard; it is also known as insulated dry-lining. Internal insulation is cheaper than external insulation, but the work is more disruptive because insulated dry-lining cannot be installed while the occupants remain in the dwelling. Door and window mouldings, skirting boards, and electrical fittings need to be removed and replaced on top of the lining after the dry-lining has been installed. Thus this type of insulation is most cost-effective when it is installed as part of a major renovation, when kitchen fittings, sanitary fittings, radiators, skirtings, architraves, etc, would be removed and replaced or refitted anyway.

The floor area of rooms with external walls is slightly reduced by dry-lining. Rooms will also heat up more quickly after the insulation is installed, so this form of insulation is particularly suited to dwellings that are heated only during the mornings and evenings.

Materials and installation

Insulated dry-lining can take the form of a composite ‘thermal board’ or a built-up system using insulation between timber battens, behind conventional plasterboard. For both systems the surface of the wall must be carefully prepared: cracked or damaged plaster should be repaired or removed; bare brickwork or blockwork should be pointed with mortar to eliminate air paths to the exterior.

Thermal board is made of plasterboard bonded to an insulating material and incorporating a vapour-control layer (to prevent water vapour passing though the board and condensing on the cold masonry behind). Thermal boards are available incorporating a variety of insulants, eg polystyrene, polyurethane and mineral wool, and the boards are normally between 25 mm and 50 mm thick overall. The thicker the board, the better the insulation. It is recommended that products with zero ozone depletion potential (ZODP) are used, wherever possible. Thermal boards should *not* be fixed on intermittent ‘dabs’ of wet plaster or adhesive unless the wall is particularly uneven: instead, continuous ribbons of plaster or adhesive should be applied.

In either case a continuous band of adhesive should be applied around the edges of the board, in order to exclude water vapour and prevent condensation occurring behind the lining.

Where insulated dry-lining is built up from conventional materials, insulation is placed between timber battens fixed to the wall. A polythene sheet is fixed over the insulation and battens before the plasterboard lining is fixed, in order to provide a vapour check. Joints, edges and service penetrations (for pipes or wires) through the polythene sheet must be thoroughly sealed with tape, in order to exclude water vapour and prevent condensation behind the lining.

Whether the dry-lining consists of thermal board or of conventional plasterboard fixed over insulation between battens, it is important that all edges, joints and service penetrations (for pipes or wires) through the plasterboard are sealed with tape and a skim of wet plaster. This will help to exclude water vapour and prevent interstitial condensation (condensation in the wall itself). Additional insulation (usually thermal board) must be installed around the cills and reveals of openings and adjacent to where internal masonry partitions meet external walls, in order to prevent thermal bridging (see GPG 138).

Fixing into dry-lining

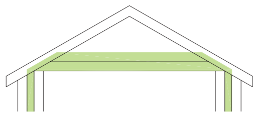
Light items (eg small pictures) may be fixed to and supported by the plasterboard lining using special fixings that are available from DIY stores and builders’ merchants. Heavy pictures, mirrors, shelves, kitchen cupboards, etc, must be fixed through the dry-lining into the masonry wall behind the insulation.

References

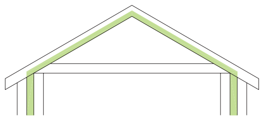
- GPG 138: *Internal wall insulation in existing housing*
- GPG 297: *Refurbishment site guidance for solid-walled houses – walls*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

C

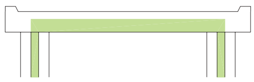
INTRODUCTION



Roof with insulated loft



Insulated roof with attic rooms



Insulated flat roof

Effectiveness

Roof insulation can reduce the heating costs by up to 20%, especially if there is no existing insulation. Roof insulation is therefore one of the first measures that should be considered; the opportunities and costs depend on the type of roof (see below).

Roof insulation should always be installed before or at the same time as any new heating system is installed, because the reduced heat loss makes it possible to install a smaller and cheaper heating system. If insulation is installed after the heating system is replaced, the boiler will be over-sized and may consequently be less efficient and more expensive to run.

When combined with wall insulation, adequate heating and controlled ventilation, roof insulation is effective in preventing surface condensation and mould growth.

Types of Roof

The main types of roof are:

- pitched roof with loft
- pitched roof with attic rooms
- flat roof.

Lofts are the easiest to insulate, and the work can be carried out at any time. Attic rooms and flat roofs in existing houses can be insulated, but the work is best done at the same time as conversion or major renovation work.

The building regulations

Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

References

- GPG 155: *Energy efficient refurbishment of existing housing*
- GPG 296: *Refurbishment site guidance for solid-walled houses – roofs*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

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PITCHED ROOFS WITH LOFTS

Introduction

Loft insulation is the most cost-effective energy efficiency measure and the easiest to install. Standards for loft insulation have increased. Some previously insulated lofts should now be 'topped up'. If there is less than 100 mm thick insulation it should be topped up to a minimum of 250 mm.

Materials

Mineral wool quilts are readily available and can be installed by DIYers. Mineral wool insulation quilt should be in accordance with BS 5803 Parts 1 and 5. For maximum effectiveness the quilt should be in two layers, one between the ceiling joists and another across them. The quilt should not be compressed when it is tucked into tight corners (eg at the eaves).

Loose-fill products are useful where access is difficult, eg beneath low-pitched roofs and above gabled dormers. The insulation can easily be topped up at any time. Blown mineral fibre should be in accordance with BS 5803 Parts 2 and 5. Blown cellulose fibre is manufactured from recycled newspaper and treated with a fire-retardant compound; this material should be in accordance with BS 5803 Parts 3 and 5.

Installation

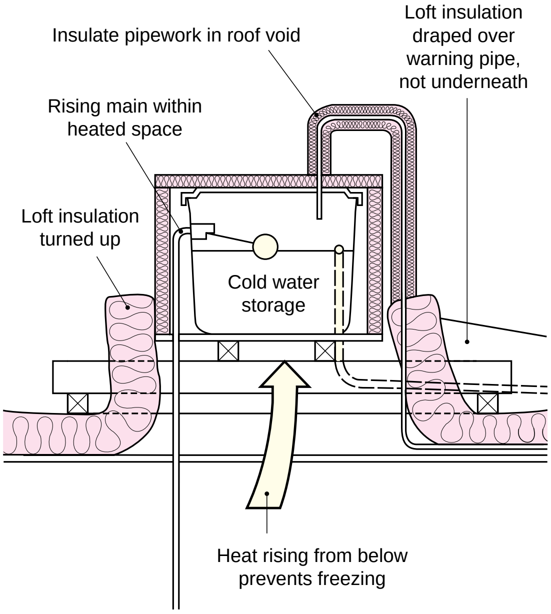
Insulation material is laid between and over the ceiling joists in the loft space to a minimum depth of 250 mm. The insulation is installed by rolling out quilt material or by blowing in loose-fill material. Quilt insulation can be installed by the householder, but it is recommended that protective clothing and a breathing mask are worn to avoid irritation by, and inhalation of, fibres. Loose-fill materials should be installed by specialist contractors.

Insulation makes the loft space *colder* than before, so water tanks and pipes in the loft must be insulated. Do *not* insulate below water tanks, but make sure that the loft insulation is continuous with the tank insulation. Alternatively, if the heating and hot water system are being replaced it is better to install a mains-pressure system and remove the tanks and pipework from the loft altogether.

The loft hatch should be insulated and draught-stripped at the same time as the loft is insulated. Alternatively, a proprietary insulated loft hatch may be installed. If the new insulation hides the ceiling joists, a safe walkway (eg from the loft hatch to the water tanks) should be provided by laying boarding on extra timbers running across the joists.

Ventilation openings into the loft from the eaves should not be blocked by the insulation; ventilation is required to reduce the risk of condensation in the loft. Large roofs should have ridge tile ventilators fitted to improve the ventilation. All holes at ceiling level should be filled, especially where pipes pass through into the loft from the bathroom and the airing cupboard. This prevents water vapour escaping into the loft, condensing on cold surfaces and causing rot. Avoid putting recessed light fittings in the ceiling beneath the loft because they cannot be sealed. Alternatively, leave a gap of 50 mm between the insulation and the fitting. If electricity cables are being renewed they should run above the insulation to avoid overheating. Where possible existing cables should be routed above the insulation.

Rolling out insulation quilt



Water tank and pipework insulation

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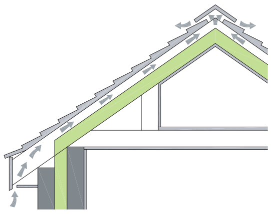
PITCHED ROOFS WITH ATTIC ROOMS



Ventilated roof construction

Sarking insulation

Introduction

Attic insulation may be installed at any time, if access is available. If there is no access, insulating an attic is most cost-effective when the roof covering is replaced. If an attic or a room-in-the-roof are being created from an existing loft, local building control should be consulted. Attics can be insulated from the inside ('ventilated roof' construction) or from the outside ('sarking insulation'). Ventilated roofs can be insulated by experienced DIYers; sarking insulation should be installed by a specialist.

Ventilated roof construction

In this type of construction, insulation material is placed between the rafters and aligned with their inner face. A ventilation gap at least 50 mm wide must be left between the top of the insulation and the underside of the roofing felt (which is laid over the rafters, beneath the slates or tiles). The ventilation gap must extend from eaves to eaves, over the whole roof; if the roof pitch is greater than 35° then ventilation must also be provided at the ridge (eg by means of ventilated ridge tiles). A vapour control layer (usually polythene sheeting) must be fixed beneath the insulation and the rafters, before the plasterboard or other linings are fixed. Where the rafters are not deep enough to accommodate sufficient insulation, extra insulation can be provided either by battening out the rafters or by using a thermal board instead of the normal plasterboard lining.

The vapour control layer is required in order to prevent water vapour from penetrating into the roof structure and condensing, leading to rot; it should be sealed with tape at all joints, edges and service penetrations (eg for pipes or wiring). It is essential that the ventilation path at the eaves and behind the insulation to the sloping part of the ceiling is not blocked. If cross ventilation cannot be provided then ventilated roof construction is not a suitable method. An alternative approach that may be adopted when the slates or tiles and the roofing felt are being replaced is to use vapour-balanced or 'breathing' construction incorporating a vapour-permeable 'breather felt'; vapour will then be able to escape through the felt and neither the 50 mm ventilation gap nor the vapour control layer need be provided. However, this approach should be checked with local building control.

Sarking insulation

In this type of construction, rigid insulation boards are installed over the rafters, beneath the roofing felt and slates or tiles. Thus sarking insulation can be installed only when the roofing felt and slates or tiles are replaced. Because the rafters are inside the insulation, there is little risk of interstitial condensation and there is no need for ventilation or a vapour control layer. A number of proprietary sarking insulation systems are available: most of them use mineral wool or polystyrene insulation boards. The insulation must be sealed to the timber rafters and the wall plate.

Insulating other parts of attics

Insulation to the vertical areas of the attic lining is normally mineral wool or rigid plastic insulation, friction-fitted between timber studwork framing. Thermal board is a convenient material for insulating the exposed 'cheeks' of dormer windows.

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FLAT ROOFS

Introduction

Flat roof insulation is worthwhile if the roof covering needs to be replaced and the roof has not previously been insulated. Other options such as polystyrene ceiling tiles are not worthwhile (polystyrene tiles are about 5 mm thick, but 50 mm thickness would be necessary for the measure to start to be effective).

The best way to insulate an existing flat roof is above the roof deck (the boarding on top of the timber joists). The insulation can be placed between the roof deck and the weatherproof covering (the 'sandwich method') or on top of the weatherproof covering (the 'inverted method').

The sandwich method

This method is appropriate when the roof covering, and possibly the roof deck, needs to be replaced. The work should be carried out by a specialist roofing contractor. The most commonly used insulation materials are polystyrene, urethane and high-density mineral wool. Materials with zero ozone depletion potential (ZODP) should be specified wherever possible.

It is not necessary to ventilate the space between the timber joists, beneath the roof deck, because the deck and joists are on the warmer side of the insulation, and condensation is therefore unlikely. However, a high-performance vapour control membrane must be bonded to the roof deck.

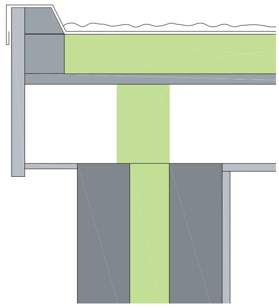
The inverted method

This method may be used when the existing weatherproof roof covering, deck and structure are to remain in place, provided the existing roof timbers are strong enough to support the extra weight. The work should be carried out by a specialist roofing contractor. The most common insulation materials are extruded polystyrene and high-density mineral wool. Materials with zero ozone depletion potential (ZODP) should be specified wherever possible.

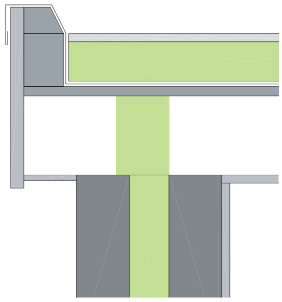
The new insulation must be completely covered and weighed down by a layer of ballast to stop it being lifted by the wind. Ballast is normally paving slabs, pebbles or cement topping to the insulation; gravel ballast may be blown away, exposing the insulant, unless the roof is designed to take account of local wind conditions.

The building regulations

Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).



The sandwich method



The inverted method

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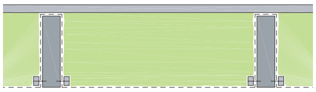
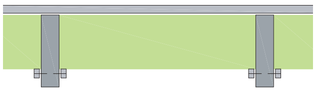
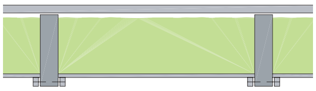
FLOOR INSULATION



Quilt insulation supported on mesh draped over the floor joists



Insulation boards supported on battens fixed to the floor joists



Quilt or blown insulation supported on mesh or board beneath the joists

INTRODUCTION

Floor insulation increases comfort. When combined with wall and roof insulation, adequate heating and controlled ventilation, floor insulation is effective in preventing surface condensation and mould growth.

Floor insulation should always be installed before or at the same time as any new heating system is installed, because the reduced heat loss makes it possible to install a smaller and cheaper heating system. If insulation is installed after the heating system is replaced, the boiler will be over-sized and may consequently be less efficient and more expensive to run.

Ground floor insulation is most effective in detached and semi-detached houses, because most heat is lost near the edge of the floor, adjacent to the outside walls. In a semi-detached house with suspended timber floors, 100 mm thick mineral wool floor insulation can reduce heat loss through the floor by up to 60%.

The main types of floors are suspended timber and solid concrete. Solid floors are usually at ground level, except in flats. Suspended floors can be ground floors or upper floors (eg above a pedestrian walkway or an integral garage).

References

- GPG 155: *Energy efficient refurbishment of existing housing*
- GPG 294: *Refurbishment site guidance for solid-walled houses – ground floors*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*

SUSPENDED TIMBER FLOORS

Floor insulation is especially worthwhile for suspended timber floors that are easily accessible (eg from a basement below). If the floor void is not readily accessible a good time to install insulation is when floorboards need to be lifted (eg to run wiring or to deal with rot).

Insulation materials can be mineral wool quilts, polystyrene boards or blown insulation. All can be installed by an experienced DIYer, except for blown insulation (which requires a specialist).

Mineral wool quilt is supported on plastic mesh or netting fixed to the sides or the undersides of the floor joists. Polystyrene boards are supported and held down against timber battens nailed to the sides of the floor joists. Blown insulation is contained within the floor void by fine mesh or boarding fixed beneath the floor joists.

The insulation should be installed right up to the edge of the floor, and any spaces between the floor joists and the external walls should be filled with mineral wool insulation in order to avoid thermal bridging. However, insulation must not block air-bricks in the outside walls, which are there to ventilate the space under the floor and prevent rot (or possibly to provide combustion air for an open-flued heating appliance).

To cut out draughts and increase comfort, the gaps between the floorboards may be filled, or thin sheets of hardboard may be laid across the whole floor. The skirting should be draught-stripped to the flooring, and all holes for services should be filled. If the floor is above a garage or basement then fire-resistant plasterboard should be fixed beneath the joists and insulation.

SOLID CONCRETE FLOORS

Insulation *below* a concrete slab is worthwhile for new floors in extensions (including conservatories) and when an existing floor has to be completely replaced. The insulation material below a concrete slab is usually polystyrene, high-density mineral wool or cellular (foamed) glass. The insulant should be dense enough to support the concrete, and if it is below the damp-proof membrane (dpm) it must be resistant to chemicals and moisture in the ground.

Insulation above a concrete slab is worthwhile only if doors, stairs, kitchen fittings, sanitary fittings and skirtings are also to be replaced, or removed and refitted. The insulation material above an existing concrete floor is usually polystyrene or mineral wool, laid in conjunction with new flooring (eg chipboard). The surface of the concrete slab must be flat and clean, to ensure that the insulation boards do not rock. Timber-based flooring used with insulation above the slab must be laid over a protective polythene damp-proof membrane, and should be tongued-and-grooved and glued at the joints. Installing this type of insulation and flooring is normally a job for a builder.

WET CENTRAL HEATING SYSTEMS

INTRODUCTION

- Modern heating systems are more efficient and less expensive to run than older ones, even if they use the same fuel.
- When combined with insulation and controlled ventilation, efficient heating helps prevent condensation and mould growth.
- Insulation should always be installed before or at the same time as any new heating system is installed, because the reduced heat loss makes it possible to install a smaller and cheaper heating system. If insulation is installed after the heating system is replaced, the boiler will be over-sized and may consequently be less efficient and more expensive to run.

Types of heating systems

There are three main types of heating systems.

- 'Wet' central heating systems have boilers and heat emitters (usually radiators).
- Other central heating systems, such as warm-air heating or electric storage heaters.
- Individual room heaters.

WET CENTRAL HEATING SYSTEMS

A wet central heating system is usually the best option for a home with two or more bedrooms. A typical system consists of a boiler and a heat distribution system such as radiators. The heating boiler may use gas, oil or solid fuel, and usually provides domestic hot water as well as space heating. GIL 59 *Central Heating System Specifications (CHeSS)* sets out recommended 'basic practice' and 'best practice' specifications for wet central heating systems.

Older boilers are less efficient than new ones. If a boiler is more than 15 years old, replacing it with a modern boiler could reduce heating costs by more than 20%. Replacing it with a condensing boiler and fitting good heating controls can reduce heating costs by 37%; if the boiler also provides domestic hot water, these savings will apply to the cost of water heating as well.

If the boiler is less than 10 years old, has adequate capacity and is in good repair then it is not usually economical to replace it. Under these circumstances it is more economical to improve the heating controls. Householders are able to use their heating systems efficiently only if they have good controls and understand how to use them.

Types of boilers

There are three main types of central heating boilers.

- Regular boilers (which also provide hot water via a separate storage tank)
- Combination or 'combi' boilers (which provide 'instant' hot water without a separate tank)
- Thermal stores (including combined primary storage units, or CPSUs)

Each of these types may be condensing or non-condensing, and condensing boilers are always more efficient. Boilers usually last for 10-15 years, but may last longer if they are properly and regularly serviced. Newer boilers are usually 'room sealed', but older boilers with 'open' vertical flues take their combustion air from the room in which they are installed and therefore require a secure permanent supply of fresh air for safety.

The efficiency of a boiler is expressed as a percentage; the higher the percentage, the more efficient the boiler and the less it costs to run. The efficiencies quoted in this Guide are typical *seasonal* efficiencies, ie they represent the average efficiencies of the boilers over a whole year. These efficiencies are known as SEDBUK (Seasonal Efficiencies of Domestic Boilers in the UK) values; the seasonal efficiencies of most boilers can be found at www.boilers.org.uk

Condensing Boilers

Condensing boilers are the most efficient type, with typical seasonal efficiencies as much as 90% or better, and they are suitable for all types of home. The efficiency remains high even when the boiler is working at low output (eg providing hot water only, during summer). These boilers achieve high efficiency by extracting heat from the hot flue gases: this causes steam in the gases to condense into water (hence the term 'condensing boiler'), generally and a condensing boiler often has a plume of water vapour (often confused with steam) emitted from the flue; it also needs a drainage connection to take away the condensate. Condensing boilers generally cost more than other types of boilers, but the extra cost is quickly recovered via reduced fuel bills, especially in larger homes. The flue must be positioned so that the plume does not cause a nuisance to neighbours.

Reference

GIL 74 *Domestic Condensing Boilers – the benefits and the myths.*

WET CENTRAL HEATING SYSTEMS

Modern non-condensing boilers

These boilers are less efficient than condensing boilers; they have seasonal efficiencies between 78% and 82%. They are usually wall-mounted, and many have fan-assisted flues. These boilers are suitable for all types of home, but low water content boilers are not recommended for dwellings with 'microbore' heating systems (with very small diameter pipework).

Combination boilers

Combination ('combi') boilers provide space heating and 'instant' mains-pressure hot water, without a header tank or a hot water storage tank. Combis may be condensing or non-condensing and have typical seasonal efficiencies ranging from 78% to 90% (for condensing types). The power of combi boilers is usually governed by the hot water requirement, and often exceeds that needed for space heating. Consequently most combi boilers are designed with modulating burners which reduce the firing rate to match the output required for space heating. How to choose between a combi and a regular boiler with a separate hot water cylinder is discussed in detail in GPG 284.

Thermal stores and CPSUs

A thermal store is an insulated water tank that is kept hot by a small boiler. When heating is required, water from the store is pumped to the radiators. When hot water is required, mains water is passed through a heat exchanger within the store and then sent to the taps. Some thermal stores have an integrated boiler that heats the store directly: these are known as combined primary storage units (CPSUs). Systems with thermal stores may be as efficient as conventional systems, but the constant heat losses from the stores tend to reduce efficiency and may cause local overheating. In order to reduce the risk of overheating, the store should have adequate insulation and comply with the Waterheater Manufacturers' Association's performance specification for thermal stores, or the better insulated best practice specification in GIL 59 (CHeSS).

Heat distribution systems

Most wet central heating systems distribute heat by circulating hot water through radiators. Some systems have under-floor pipes instead of radiators, and 'kick-space heaters' (small fan-assisted radiators) are sometimes found beneath kitchen cupboards. In older 'gravity feed' systems, the hot water circulates by convection; in all modern systems the hot water is circulated by an electric pump. Gravity feed systems are less efficient than fully pumped systems, because they are less well controlled. For best practice new central heating systems should always be fully pumped; older gravity feed systems and semi-gravity feed systems (in which the pump is used only for the radiator circuit and not for the hot water cylinder) should be upgraded to fully pumped when the boiler is replaced or the controls are improved.

Controls for wet central heating systems

The provision of good heating and hot water controls in a typical semi-detached house can save as much as 15-20% of the heating costs per year. Heating controls may be upgraded at any time, but a good time to upgrade is when the boiler is being replaced or when carrying out other work on the heating system. Heating controls in common use include:

- A ***programmer*** or ***time-clock*** that allows daily or weekly heating periods for heating and hot water to be programmed in advance.
- A ***full programmer*** allows the time settings for heating and hot water to be fully independent.
- A ***room thermostat*** that monitors the air temperature within one room and turns the heating on and off in order to maintain a temperature set by the user.
- A ***programmable room thermostat*** is a combined time switch and room thermostat that allows the user to set different target temperatures for different time periods.
- A ***delayed start thermostat*** will delay the switching on of the heating system beyond the programmed time if the house is already warm enough. Wireless versions of all these devices are available for use in existing dwellings. Room thermostats should not be fitted near radiators, in draughty or sunny locations, or above other heat-producing objects such as table lamps or televisions.
- ***Thermostatic radiator valves*** (TRVs) sense the temperatures in individual rooms and control

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WET CENTRAL HEATING SYSTEMS

the heat output from radiators by adjusting the water flow. TRVs are relatively inexpensive and six TRVs can save their own cost in just a few years. TRVs should not be fitted to radiators in rooms where there is a room thermostat.

- ***Boiler interlock*** is not a physical device but a way of wiring the system controls (eg a programmer, a room thermostat, a cylinder thermostat and one or more motorised valves) so as to ensure that the boiler does not fire when there is no demand for heat. This is important to avoid the boiler starting up at intervals and cycling on the boiler thermostat.
- A ***boiler energy manager*** or ***intelligent heating controller*** is an electronic device that either: adjusts the amount of heat delivered to the house according to the outside temperature; or delays the start of heating if the house is already warm enough; or turns the heating off if the TRVs have all closed down (by sensing the temperature or pressure of the water returning to the boiler); or runs the circulating pump after the boiler has stopped firing in order to retrieve residual heat from the heat exchanger; or a combination of some or all of these features.
- An ***automatic bypass valve*** controls water flow in the circulation system in accordance with the water pressure across it; it is used to maintain a minimum flow rate through the boiler and limit circulation pressure when some paths are closed (eg by TRVs and/or motorised valves). An automatic bypass valve is essential in many systems to ensure that minimum flow rate is maintained in the boiler when TRVs have closed down.
- Motorised valves controlled by the thermostats and programmers are used to direct the flow of hot water around the circulation system, to different zones of the house, or to the hot water storage tank.

Larger houses should be divided into at least two control zones (typically living and sleeping zones), and the controls should be arranged so that the heating in each zone can be separately timed and thermostatically controlled. GIL 59 *Central Heating System Specifications (CHeSS)* identifies recommended specifications for 'basic' and 'best practice' sets of controls for wet central heating systems. An efficient, fully pumped system should always include a full programmer (or a time-clock with a combi boiler), at least one room thermostat, boiler interlock, TRVs on all radiators (except in rooms with room thermostats) and an automatic bypass valve if a bypass circuit is needed.

The building regulations

Part L1 of the Building Regulations (England and Wales) specifies that new and replacement heating boilers must meet minimum standards of efficiency. New wet central heating systems must be fully pumped (and not rely on 'gravity feed' circulation) and equipped with time control (eg a programmer) and temperature control (eg room thermostats and/or thermostatic radiator valves in each control zone). If any major change (such as boiler replacement) is carried out the system should be upgraded to fully pumped and the heating controls must be upgraded to minimum standards. The householder must be provided with information about how a new or upgraded central heating system may be operated energy efficiently (see notes).

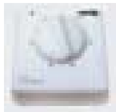
For gas and oil fired fired central heating and hot water systems, reputable installers who are registered under the Benchmark self-certification scheme administered by the Central Heating Information Council may certify the compliance of the installation. This is done by completing the Benchmark logbook supplied with the boiler and (if appropriate) the Benchmark label affixed to the hot water tank by the manufacturer.

For oil fired systems, a self-certification scheme known as the Oil Firing Registration Scheme is operated by the Oil Firing Technical Association (OFTEC). For solid fuel systems a self-certification scheme known as the HETAS Registration Scheme is operated by the Heating Efficiency Testing and Advisory Service (HETAS).

Notes

- Energy efficient gas boilers and heating controls can be identified by the Energy Efficiency Recommended logo (page 32)
- Building regulations in Scotland and Northern Ireland vary from those in England and Wales. Requirements for fully pumped systems do not apply and system controls vary between all the nations. It is always preferable that 'best practice' is applied (GIL 59 CHeSS) but if in doubt contact the building control at the local authority (contact details for building regulations are at the back of this publication).

A Programmer



A Room Thermostat

A Thermostatic radiator valve

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OTHER CENTRAL HEATING SYSTEMS

Storage heater controls

Electric Storage Heating

Electric storage heating consists of heaters that are 'charged' with heat during the night, using an off-peak electricity tariff such as 'Economy 7', and which then emit the heat when required during the day. The storage heaters are usually supplemented by on-peak electric convector or panel heaters. The correct combination of off-peak storage heaters and on-peak panel heaters depends on the size of the house and the amount of insulation.

Modern, slimline storage heaters are smaller than older, high-volume heaters, yet may have the same capacity; they are better insulated, so heat is given out less quickly. Fan-assisted storage heaters are the most effective: these incorporate a fan to extract heat from the core when more heat is required than is being emitted though the casing. Some types of storage heater include a convector to provide occasional (on-peak) top-up heating. Electric storage heating may have manual control or automatic charge control, with various types of output control.

Manual control consists of knobs with which the user sets the amount of heat to be stored in the heater overnight and the rate of heat output. The settings must be judged every evening and morning against the likely temperature overnight and the following day, and the likely demand for heat (eg hours of occupancy). Output controls can include room thermostats and timers that control the extract fan or on-peak convector.

Automatic charge control sets the amount of heat stored overnight according to the internal temperature at that time; this is a reliable method of assessing the amount of heat that will be required the following day. Some systems set the amount of heat stored overnight according to the *external* temperature at that time, or to a weather forecast signal.

Some electricity suppliers offer special off-peak tariffs that allow storage heaters to be given a short off-peak top-up charge in mid-afternoon. These tariffs are not usually any more economical overall than the standard off-peak tariffs, but they do improve comfort by helping to ensure that the storage heaters do not run out of charge on cold winter evenings.

Warm air heating

Warm air heating systems can run on natural gas, LPG, oil or electricity. The heater is usually located in the centre of the dwelling, and there are two types of distribution systems: 'fully ducted' and 'stub ducts'. Some new models also provide hot water via a storage tank, or circulate hot water to radiators. Modern, integrated controls vary the fan speed to match the firing cycle of the burner. The seasonal efficiencies of modern warm air systems with good controls are typically 78% or higher.

Fully ducted systems include ducts to carry warm air from the heater to the perimeter of the dwelling, where it is distributed so as to minimise the cold effect of external walls and windows. Cool air returns to the heater from heated rooms via grilles. Stub duct systems are often installed in smaller dwellings: they include short ducts to carry the warm air from the heater to each room, where it is distributed at the nearest point to the heater. If the heater is well sited, few or no ducts will be required.

A warm air heating system should be controlled by a programmer and a room thermostat. Individual air supply grilles sometimes have sliding 'dampers' with which the supply of warm air may be adjusted. For efficient operation, air supply and return grilles and filters should be kept clean. In order to reduce the risk of condensation and eliminate unwanted odours there should be no possibility of air from the kitchen or bathroom being recirculated to the rest of the house.

Individual room heaters

Individual room heaters in living rooms can supplement central heating in winter and provide occasional heating in summer. A well-insulated small flat or house may not require a central heating system: one or two room heaters may be sufficient. There are several types of room heaters, which run on natural gas, bottled gas (LPG), electricity, solid fuel or oil. Better types of room heaters are equipped with

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OTHER CENTRAL HEATING SYSTEMS

time and temperature controls. Unless it is electric or has a balanced flue, an individual room heater must have a supply of combustion air brought into the room from outside.

Portable bottled gas and paraffin heaters are not recommended because they have no chimney or flue for exhaust gases to escape through. Substantial ventilation (involving significant heat loss) must be provided to remove carbon dioxide and water vapour, otherwise there is a significant risk of surface condensation and/or asphyxiation of the occupants.

Natural gas heaters include wall-mounted models as well as traditional open hearth and fireplace installations. Wall-mounted heaters provide more flexibility of siting within the room, depending on the type of flue. Some models must be fitted on an external wall, but others can be fitted on an internal wall with the flue routed to an external wall. The efficiencies of natural gas heaters vary. Some decorative ‘open-basket’ focal-point heaters have efficiencies as low as 20%, but the efficiencies of closed radiant convector heaters, including some with the popular coal effect, can be 75% or more.

Electric room heaters such as panel heaters, convector heaters and radiant heaters are 100% efficient (all the energy in the electricity is turned into heat in the room) but they are very expensive to run because they use on-peak electricity. Wherever possible they should be equipped with programmers or time-clocks, and thermostatic controls.

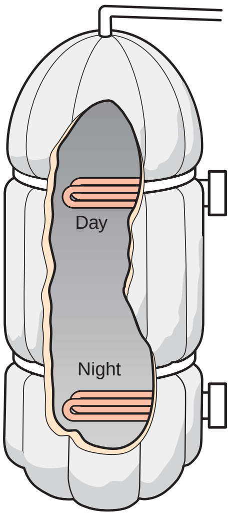
Solid fuel room heaters include open and closed solid fuel fires with and without back boilers (to provide hot water) and free-standing solid fuel stoves. Closed room heaters (with glass doors) and stoves are much more efficient than open fires. In most urban areas only smokeless fuels may be used. Open fires should be equipped with chimney throat restrictors over the fire to control the amount of air drawn from the room.

Oil filled radiators are normally free standing although they can sometimes be wall mounted. They are normally used to provide additional background heat rather than being the main source of heat and can be expensive to run because they generally use on-peak electricity. Wherever possible they should be fitted with programmers or time clocks and thermostatic controls. Oil fired room heaters supplied from an external storage tank are also available.

References

- GPG 155: *Energy efficient refurbishment of existing housing*
- GPG 284: *Domestic central heating and hot water systems with gas- and oil-fired boilers*
- GPG 301: *Domestic heating and hot water systems*
- GPG 302: *Controls for domestic central heating and hot water: guidance for specifiers and installers*
- GIL 59: *Central Heating System Specifications (CHeSS) Year 2002*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*
- *The Domestic Heating and Hot Water Guide to the Building Regulations 2001*, published by the Energy Efficiency Partnership for Homes
- *Boiler Efficiency Database* – www.boilers.org.uk or *The Little Blue Book of Boilers*

HOT WATER SYSTEMS



Electric immersion heater

Hot water cylinder

Types of hot water systems

There are four main types of domestic hot water system.

- Hot water storage cylinders incorporating electric immersion heaters (using on-peak or off-peak electricity).
- Hot water storage cylinders that are supplied with heat by space-heating boilers or by back-boilers behind room heaters; this type of water heating is usually part of a wet central heating system.
- Combination or 'combi' boilers that provide space heating and deliver hot water on demand, without tanks (although some 'storage combi' boilers have tanks inside the boiler casing to improve the delivery rate).
- Instantaneous gas fired water heaters (single-point or multi-point) that supply mains-pressure hot water on demand.

Opportunities for improving water heating systems

- Hot water storage cylinders may be insulated at any time. This is an inexpensive measure that is very cost-effective, even if the cylinder already has some insulation. The cost of fitting a jacket on a DIY basis can often be recovered within a year through reduced fuel costs: a jacket fitted to an uninsulated cylinder can save up to twice its own cost in the first year.
- Replacement of a heating boiler or upgrading of a heating system often provides an opportunity to improve the hot water system. If a new, efficient boiler is being installed to provide space heating then it makes sense to take advantage of the efficiency of the boiler by arranging for it to supply hot water as well, via a new, efficient, insulated hot water cylinder.
- Pipework insulation should be installed when lofts are being insulated, or when the pipework is exposed while new kitchen or bathroom fittings are installed.
- Hot water system controls should be upgraded at the same time as heating system controls.

Hot water storage

New hot water storage cylinders should be insulated with at least 50 mm thick factory-applied polyurethane foam and conform to BS 1566:2002. Older cylinders should be fitted with insulating jackets (available from DIY stores). Jackets should be at least 80 mm thick, conform to BS 5615, and be wrapped around the tanks leaving no gaps and securely strapped into place.

Hot water cylinders for use with space heating boilers should be of the 'rapid recovery' type to BS1566:2002 and in accordance with the 'best practice' specification in GIL 59 (CHeSS); this type of cylinder makes better use of the boiler capacity and thus improves efficiency. If the incoming water supply is adequate it is a good idea to consider a mains-pressure hot water system, in order to remove tanks and pipework from the roofspace.

If water is heated by electricity, a large hot water storage cylinder (at least 210 litres) should be used, with a dual immersion heater. This type of system includes an electric immersion heater at the bottom of the cylinder, for heating the entire tank using off-peak electricity, and another immersion heater at the top, for 'topping up' using more expensive on-peak electricity. If the tank is not large enough, more frequent top-ups will be required, resulting in higher fuel costs.

Combination boilers

Modern combi boilers are suitable for most houses, except those where simultaneous use of several taps is likely. A combination boiler is a good option for a flat or small house where space is at a premium, because there is no need for a hot water cylinder. Before selecting a combi boiler it is important to check that the dwelling has satisfactory water pressure and an adequate supply pipe size, in order to avoid the risk of inadequate hot water delivery.

Combination boilers supply hot water at mains pressure, which makes them compatible with the types of showers that work best with similar pressures in the hot and cold supplies. Mains-pressure systems do not require header tanks, so there is no need for tanks or pipework in unheated lofts. Some combis include hot water storage within the boilers themselves, in order to improve the

HOT WATER SYSTEMS

delivery of hot water; these models perform better and save water, but use more energy. For a discussion of the relative advantages of combis, storage combis and storage cylinders see GPG 284.
Note – The mains water pressure should be checked to ensure that it is compatible for such systems.

Other instant water heaters

Modern gas-fired instantaneous water heaters are usually wall-mounted, room-sealed and have balanced flues. (Older gas-fired instantaneous water heaters with open flues, which take combustion air from the room, are dangerous because of the risk of asphyxiation: these appliances should always be replaced by modern, room-sealed heaters). Single point heaters supply only one tap; multi-point heaters supply several taps. In both types the burner is controlled by a pressure switch that senses when a hot water tap is opened; water is usually supplied at mains pressure, so there is no need for a header tank. These types of water heater are not suitable for supplying showers.

Pipework insulation

The primary pipework between the boiler and the cylinder should always be insulated. It is also worth considering insulating the secondary pipework, between the cylinder and the taps. Tanks and pipework in lofts should always be insulated, to prevent freezing and the risk of bursts. Two types of pipework insulation are available: pre-formed foam insulation in the form of a split tube that is pushed over the pipe; and 'strip' insulation supplied in a 75 mm wide roll that is wrapped around the pipe.

Controls for hot water systems

The proper use of good hot water controls ensures that fuel is not wasted. Controls may be upgraded at any time, but a good time is when the heating boiler or hot water cylinder are being replaced. Controls in common use include:

- A ***programmer*** or ***time-clock*** that allows daily or weekly water heating periods to be programmed in advance. In a wet central heating system a ***full programmer*** allows the time settings for heating and hot water to be fully independent.
- A ***hot water cylinder thermostat*** that fits on to the hot water storage cylinder and switches the water heating off when the set temperature is reached. The recommended temperature setting is 60-65°C.

Systems can be configured to give priority to hot water over space heating: in most cases this will permit rapid re-heating of the cylinder without a perceptible effect on the house temperature.

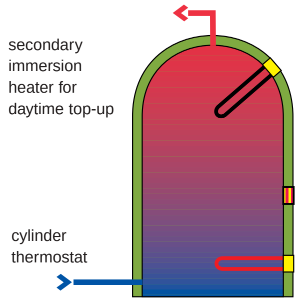
In boiler-based systems, the primary pipework between the boiler and the cylinder should be insulated. The hot water cylinder should be equipped with a thermostat, and the thermostat should be interlocked to the boiler by a motorised valve to ensure that the boiler does not fire when the water is already hot enough. The system should also be fully pumped (not 'gravity feed') and controlled by a full programmer or time-clock, so that the time settings for water heating may be independent of those for space heating.

The building regulations

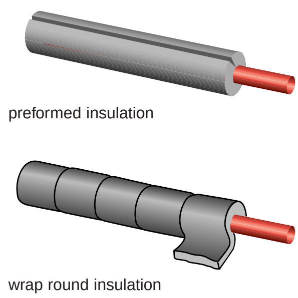
Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

References

- GPG 155: *Energy efficient refurbishment of existing housing*
- GPG 284: *Domestic central heating and hot water systems with gas- and oil-fired boilers*
- GPG 301: *Domestic heating and hot water systems*
- GPG 302: *Controls for domestic central heating and hot water: guidance for specifiers and installers*
- GIL 59: *Central Heating System Specifications (CHeSS)*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*



Dual immersion system



Primary pipework insulation

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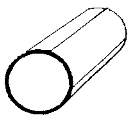
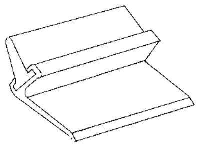
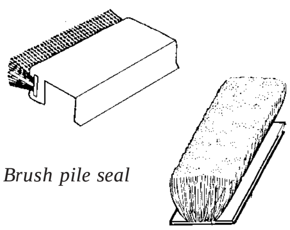
DRAUGHT-STRIPPING



Silicone O strip



Fin or blade seal



Brush pile seal

Introduction

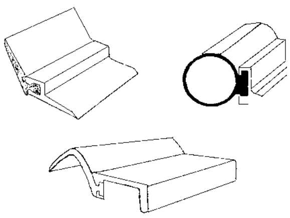
Badly fitting doors and windows and gaps around skirtings and loft hatches, are all major sources of heat loss. Draught-stripping is inexpensive and simple to install and can greatly increase comfort as well as reducing fuel costs.

Skirtings that are being replaced or refitted should always be seated on seals in order to reduce heat loss and prevent draughts.

Draught-stripping for windows

There are three main types of draught-stripping for windows.

- Silicone O strip, available in a variety of sizes (for gaps up to 10 mm wide) and glued into place with silicone adhesive.
- Neoprene fin or blade seals, which are good for sealing wooden doors, casement windows and some sliding windows.
- Brush pile draught-stripping, which is available in self-adhesive form or bonded to a plastic carrier strip. Various pile-heights are available, and this type of draught-stripping is suitable for most door and window types, especially sliding ones. Care is needed when repainting in order to avoid damage to the pile.

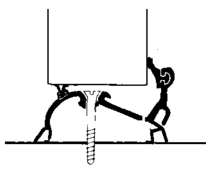


Draught-strips for external doors

Draught-stripping for external doors

A variety of types of seals is available, including good-quality rubber seals (silicone or EPDM), sheathed foam and nylon brush seals. Some types have PVC-U or aluminium carrier strips that are nailed or screwed to the sides and tops of the door frames. All these seals should be fitted with an initial compression of 3 mm, to allow for seasonal movement of the doors.

Threshold seals are usually made from aluminium and incorporate flexible weather strips. Special seals are available for use where level thresholds are required to permit wheelchair access.



Threshold seal

Points to watch

- If the windows do not incorporate trickle ventilators then the top edges should not be sealed. However, it is more effective to seal the tops of the windows and install trickle ventilators in the window heads.
- Loft hatches should be sealed to prevent warm moist air entering the roofspace, resulting in condensation and possible rot.
- Adequate, permanent ventilation MUST be provided to permit the entry of combustion air for all open-flued heating and hot water appliances, including open fires. After any draught-stripping or sealing work the safe operation of all open-flued appliances should be checked.

Replacement windows and doors are draught-stripped. Reasonable sealing measures should be included whenever substantial alterations are made to walls, floors or roofs. Where floor boards are lifted and refitted or replaced the gaps between them should be sealed. New plasterboard wall and ceiling linings should be sealed at all joints, edges and service penetrations (eg light switches, power points, ceiling roses, etc).

The building regulations

Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

References

- GPG 295: *Refurbishment site guidance for solid walled houses – windows and doors*
- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*
- GPG 155: *Energy efficient refurbishment of existing housing*

CONTROLLED VENTILATION

Introduction

In a typical two-storey semi-detached house approximately 16% – 20% of the total heat loss is through uncontrolled ventilation. By contrast, controlled ventilation minimises heat loss by providing only the required amount of fresh air.

The purpose of controlled ventilation is to supply combustion air for open-flued appliances (eg gas fires, solid fuel stoves) and to maintain good air quality for healthy living conditions. Controlled ventilation also reduces the risk of condensation when warm moist air inside the house meets a colder surface.

The main types of ventilation are:

- Local background ventilation (eg trickle ventilators) to provide a steady flow of fresh air
- Local rapid ventilation (eg extract fans) to remove stale air and moisture
- Whole-house passive stack ventilation
- Whole-house mechanical ventilation, which extracts stale air and supplies fresh air, usually with heat recovery.

Whichever ventilation system is installed, it is essential to make sure that the householder knows how to use it and understands the importance of not blocking fresh air vents or disabling extract fans. Open flued appliances (ie those drawing their combustion air from the room rather than from outside) need permanent ventilators, which should be installed as close to the appliances as possible in order to minimise draughts.

Local background ventilation

The simplest way of providing background ventilation is by installing trickle ventilators in the heads of window frames. Trickle ventilators are inexpensive, and require no maintenance. They are not usually adequate on their own, but they do reduce the need for windows to be opened. Trickle ventilators also improve security because they avoid the need for windows to be left open when the house is unoccupied. They are not suitable for high-rise flats because of the high external winds.

In some older houses background ventilation is provided by air-bricks or fixed ventilators. It is best to replace these systems, if possible, with new through-the-wall ventilators incorporating controls, or with trickle ventilators.

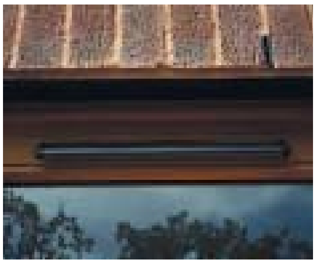
Local rapid ventilation

Rapid ventilation can be provided by opening a window. However, a more controlled and secure method is to install electric extract fans, which are mounted in windows, walls or ceilings and expel stale or moist air from the dwelling.

Extract fans are inexpensive and easy to maintain. They are usually installed in kitchens and bathrooms in order to ensure that moisture-laden air from cooking and bathing is expelled before it can be distributed around the house. Fans are most effective when installed at high level away from sources of fresh air (eg doors, windows and trickle vents). In kitchens, they can be incorporated in cooker hoods. Fans should include baffles that close off the ducts when the fans are not in use and mesh screens to prevent insects from entering. Modern fans are very quiet, but they require careful installation in order to minimise noise due to vibration. The latest 'low wattage' fans incorporate DC motors and are very energy efficient.

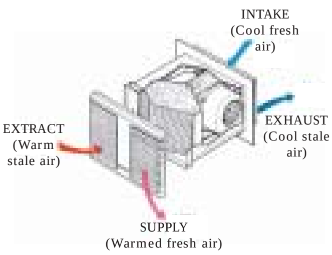
Extract fans may be controlled manually. In bathrooms they are often linked to light switches, and they may incorporate an adjustable 'run on' facility that keeps the fan running for a period after the light has been switched off. Fans may also be controlled by humidistats, which sense the humidity in the room and switch a fan on when a set level is reached.

Heat recovery room ventilators (HRRVs) are combined supply and extract fans that recover heat from the extracted, warm air and use it to warm up the incoming fresh air. Thus they provide rapid ventilation without the associated heat loss. HRRVs are usually mounted through external walls, and run continuously with a high-speed 'boost' when internal humidity is high.



Trickle ventilator

Extract fan



Heat recovery room ventilator

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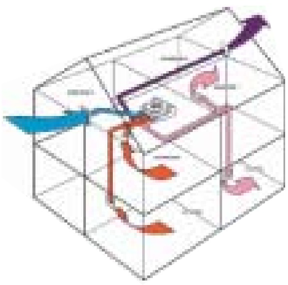
CONTROLLED VENTILATION

Passive stack ventilation



Cool stale air exhaust
Warm stale air extraction
Pre-warmed fresh air supply
Cool fresh air intake

Whole-house mechanical ventilation

Whole-house passive stack ventilation

Passive stack ventilation (PSV) is an alternative method of providing both continuous background ventilation and rapid ventilation, when required. Warm stale air is extracted via ducts that run from ceiling grilles in kitchens and bathrooms to roof terminals. Fresh air enters the dwelling via trickle ventilators in the window heads. Air is moved continuously, at varying rates according to the external wind speed, without the need for fans, and almost silently. Air movement is promoted by the natural buoyancy of warm air, and assisted by the pressure difference between inside and outside caused by the passage of wind across the roof.

Passive stack ventilation is more expensive to install than extract fans. The ducts are between 80 mm and 125 mm in diameter; they must be relatively straight and well sealed, and they are usually boxed. Consequently it is worthwhile installing passive stack ventilation in an existing house only as part of an extensive refurbishment. A good option is to combine a kitchen extract ventilation fan (in a cooker hood) with passive stack ventilators in upstairs bathrooms.

Whole-house mechanical ventilation

The simplest form of whole-house mechanical ventilation is positive pressure ventilation (PPV). Systems of this type use a lower-power fan to draw air into the house continuously, via the roofspace, and supply it to the upper floor (usually above the stairwell). Air is drawn in via the roofspace because heat losses from the house to the roofspace will ‘pre-heat’ the supply air slightly. Stale air is then allowed to escape from the house, under the positive pressure created by the fan, through trickle ventilators or gaps in the building fabric. No heat recovery is involved, except for the slight pre-heating of supply air as it passes through the roofspace; note that the pre-heating effect will be negligible in a house with a cold loft above well-insulated ceilings. There is also a risk of interstitial condensation within the construction, because the fan pressure drives warm, moist air into crevices in the walls and roof, where it may meet cold surfaces.

A more expensive but more effective form of whole-house ventilation is mechanical ventilation with heat recovery (MVHR). An MVHR system extracts moist, stale air (usually from ‘wet’ spaces such as kitchens and bathrooms) and supplies filtered fresh air (usually to living spaces and bedrooms). The extracted air is passed through a heat exchanger where some of the heat is transferred to the incoming fresh air. The heat exchanger is connected by ductwork to input and exhaust terminals at roof level, and to supply and extract grilles within the house.

It is important that a house with MVHR is well sealed, and that the heat exchanger is located within the insulated envelope (not in a cold roofspace) otherwise the advantages of heat recovery will be lost. Filters must be kept clean in order to maintain efficiency. An MVHR system can have high heat recovery efficiencies, but the resultant fuel cost saving is offset by the cost of running the supply and extract fans continuously. Consequently, MVHR systems are rarely cost-effective energy efficiency measures, unless the house is heated by electricity or another similarly expensive fuel. The most efficient, modern systems incorporating plastic cross-flow heat exchangers have high heat recovery efficiency and use DC motors to reduce the fan power.

However, MVHR systems do significantly reduce the risk of surface condensation, and they provide excellent air quality. They are particularly useful in houses where there are asthma or allergy sufferers, or condensation problems, or where the windows cannot be opened, perhaps because of traffic noise or outside air pollution.

C

CONDENSATION, DAMP AND MOULD

Introduction

Damp can cause mould on walls and furniture and timber window frames to rot. Mould growth is unsightly and causes damage to finishes and to the building fabric; it is also unhealthy for occupants, and can lead to respiratory problems. Some damp is caused by condensation.

What causes condensation?

When warm, moist air comes into contact with a cold surface its temperature drops causing some moisture to condense as water. Condensation occurs mainly during cold weather, when the inner surfaces of external walls and ceilings are colder (especially if they are poorly insulated). The colder the surface and the more moisture the air contains, the more condensation will form. Thus condensation can be caused by lack of insulation, lack of adequate heating (which dries the air) and lack of ventilation (which removes moist air); most commonly, condensation is caused by a combination of all of these factors.

Condensation usually occurs first on single glazing, then on parts of external walls and ceilings where there is little or no insulation (these areas are known as ‘thermal bridges’). Installing double glazing reduces the risk of condensation on windows; installing insulation reduces the risk of condensation on walls and ceilings. However, experience has shown that serious condensation problems can be eliminated only by a combination of better insulation, more heating and improved ventilation.

How to reduce condensation

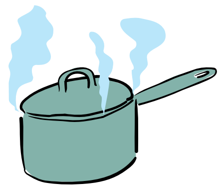
To reduce condensation, take all of the following steps.

- Produce less moisture: avoid using flueless paraffin and bottled gas heaters; ensure that tumble driers are vented to the exterior, not into the dwelling; keep bathroom doors closed; and cook with lids on pans.
- Ventilate: install extract ventilation fans (see page 27) in the kitchen and bathrooms to remove moisture at its source; install trickle ventilators in other rooms to ensure a supply of fresh air.
- Insulate, draught-strip and provide controlled ventilation: insulate the external walls (see pages 11, 12, 13) and the loft (see pages 14, 15, 16); draught-strip around doors and windows (see page 26), and provide controlled ventilation (see pages 27, 28).
- Heat the home adequately: if the house is centrally heated, install TRVs (see page 20) to permit background heating of rooms that are not often used; otherwise install a small heater that can run all day at low output.

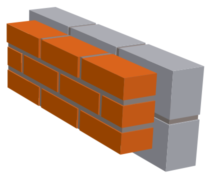
Providing the right amount of controlled ventilation will ensure a healthy, odour-free and mould-free home. Controlled ventilation that is provided in conjunction with improved insulation and better heating will not make the house colder.

Reference

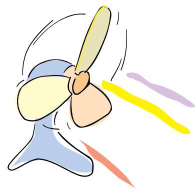
- GPG 155: *Energy efficient refurbishment of existing housing*



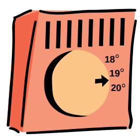
Produce less moisture



Insulate and draught-strip



Ventilate



Provide adequate heating

WINDOWS

Introduction

An existing, single glazed window will allow twice as much heat to escape as the same area of uninsulated solid brick wall, and *fourteen* times as much as a modern, well-insulated wall. Even double or triple glazing with wide-spaced panes, low-emissivity coating and/or gas filling will allow six times as much heat to escape as a well-insulated wall. It is therefore very cost-effective, when replacing windows, to specify the highest performance that can be afforded.

Double glazing improves comfort and reduces condensation. For new houses, high-performance double glazing with wide gaps and low-emissivity coating and/or gas filling has become standard. In existing houses, high-performance double glazing should be added when windows are replaced. Good quality secondary glazing is cheaper than new double glazing. Curtains help to reduce heat loss at night, but they are not as effective as secondary glazing.

Types of windows and glazing

New and replacement windows usually have timber, PVC-U or metal frames. Windows with timber or PVC-U frames generally perform better than metal framed windows. Timber frames require regular maintenance; PVC-U frames need less maintenance. Metal frames are made from anodised aluminium or steel with various finishes; they should always include 'thermal breaks', which reduce heat loss by isolating the inner and outer parts of the frames.

Modern high-performance glazing consists of sealed double- or triple-glazed units. Panes may be spaced up to 20 mm apart and the units should include low-emissivity coatings and/or gas fill between the panes to reduce heat loss. 'Soft' low-emissivity coatings reduce heat losses more than 'hard' coatings, but are more expensive.

Gas fill is usually argon, but krypton and xenon are also used; argon is the cheapest but least effective; xenon is the most expensive and the most effective.

All opening windows should be draught-stripped. If the house is naturally ventilated or has passive stack ventilation then trickle ventilators should be fitted in the heads of the frames (see page 27). If the house has mechanical supply and extract ventilation, trickle ventilators should not be fitted.

Secondary glazing

Secondary glazing is usually made of glass in aluminium or plastic frames; flexible plastic glazing can also be used. Some secondary glazing can be bought in kit form and installed by a competent DIYer; others are factory-made to fit the windows, and professionally installed. Whichever type is used, secondary glazing can be a cost-effective energy efficiency measure and will reduce draughts and condensation. If the primary and secondary panes are at least 150 mm apart secondary glazing can also provide effective sound insulation. To avoid condensation on the outer pane, only the secondary glazing (not the original frame) should be draught-stripped. Allowance should also be made for safe cleaning and for escaping through the window, in the event of fire.

The building regulations

Building regulations vary between England and Wales, Scotland and Northern Ireland. It is recommended that the building control in the local authority is consulted before any work of this nature is commenced (see page 38).

References

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- GIL 70: *The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)*
- GPG 295: *Refurbishment site guidance for solid walled houses – windows and doors*

C

ENERGY EFFICIENT LIGHTING

Introduction

In most homes, lighting accounts for between 10% and 15% of the electricity bill. Installing energy efficient lighting can provide savings of up to ten times the cost of the lamp over its lifetime, even though energy efficient lamps are initially more expensive than conventional ones.

Energy efficient lighting can be installed at any time, anywhere in the house but the lamps in rooms where the lighting is most often used should be replaced first. These are usually the living room, kitchen and hall, but any room in which the lighting is used for more than four hours per day should be considered. Energy efficient lamps are particularly cost-effective for lighting that is used throughout the night, eg external security lighting or lighting for porches, access balconies, stairwells or corridors. If light fittings are being replaced, consider installing fittings that will accept only 2-pin or 4-pin compact fluorescent lamps. These lamps are less expensive than the ‘plug-in’ compact fluorescent lamps with conventional Edison screw or bayonet caps.

Types of energy efficient lamps

Energy efficient lighting is lighting with luminous efficacy more than 40 lamp lumens per circuit Watt. There are two main types of energy efficient lamps: fluorescent tubes; and compact fluorescent lamps (CFLs). Energy efficient light bulbs can be identified by the Energy Efficiency Recommended logo (see page 32).

Fluorescent tubes should be installed in fittings with high frequency ballasts. Lamps with high frequency ballasts do not flicker and are up to 20% more efficient than lamps with low frequency ballasts. The new, slimmer types of fluorescent tubes (with diameters of 26 mm or less) are cheaper and significantly more efficient than the older 38 mm diameter tubes. These types of lamps are suitable for kitchens, garages and workshops. Dimmable high frequency ballasts are available.

Compact fluorescent lamps can last up to twelve times as long as conventional tungsten lamps and use as little as 25% of the energy for an equivalent light output. ‘Plug-in’ CFLs with Edison screw or bayonet caps are designed to replace conventional tungsten lamps in existing fittings. The cheaper 2-pin or 4-pin CFLs are designed for use in dedicated fittings that incorporate the ballasts; these fittings should be installed in new accommodation such as extensions, loft conversions and conservatories.

Modern CFLs provide light of very good quality and a large range of types is available, including spot lamps, candle lamps and coloured lamps of every description. The multi-tube lamps have high frequency ballasts, light up instantly and quickly reach their full brightness; globe type CFLs take longer to light up and reach their full brightness. However, CFLs do lose some brightness over their life, so it is a good idea to choose CFLs with equivalent Wattage slightly higher than those of the conventional lamps that they replace, eg replace a 60 Watt tungsten bulb with a 15 Watt CFL. Special dimmer switches are required for use with CFLs.

Tungsten-halogen lamps are good for spot lighting and task lighting. However, they are not recommended for lighting large areas.

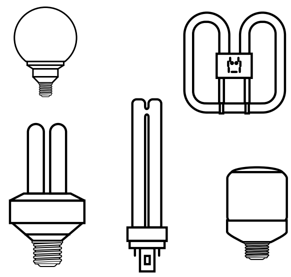
The Building Regulations

Building Regulations may apply in England and Wales. Advice should be sought from the local authority building control (see page 38).

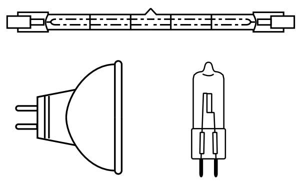
Reference

- GIL 20: *Low energy domestic lighting – a summary guide*

Fluorescent tube



Compact fluorescent lamps



Tungsten halogen lamps

C

ENERGY EFFICIENT DOMESTIC APPLIANCES

Look for the Ecolabel symbol

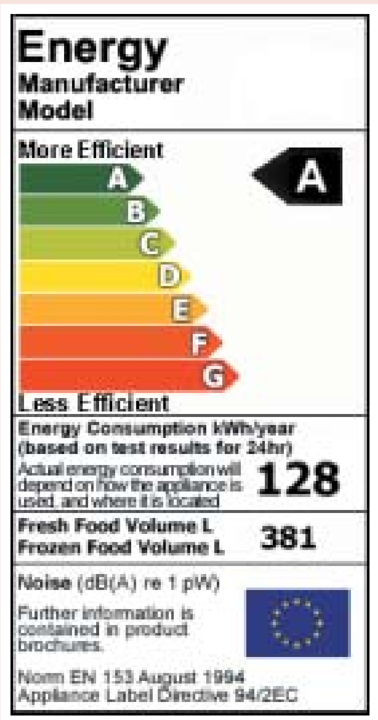
Introduction

Energy efficient domestic appliances use less electricity and are therefore less expensive to run and produce less atmospheric pollution. There is ample evidence that energy efficient appliances are often no more expensive to buy than equivalent appliances that are much less efficient. When buying an appliance, look for the energy label.

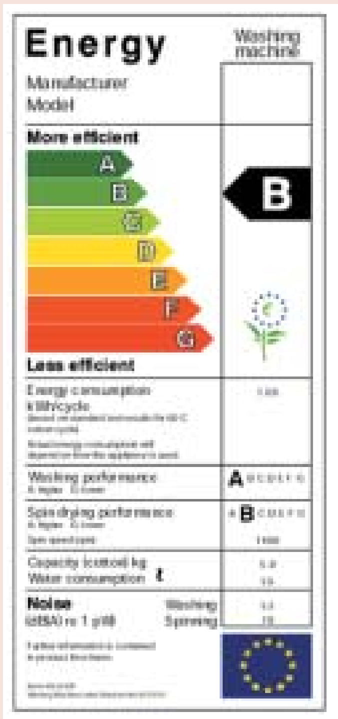
Energy labelling

In 1995 the European Union introduced a compulsory energy labelling scheme for household appliances, covering refrigerators, freezers and fridge-freezers. This scheme has subsequently been extended to include washing machines, tumble dryers, washer-dryers, dishwashers and lamps. Energy labels are displayed on these products in shops and showrooms, in order to allow potential purchasers to compare their efficiencies.

The energy labels show estimated fuel consumption (based on standard test results) and an energy grading from A to G (where A is the most efficient). An A-rated appliance will use approximately half as much electricity as a G-rated appliance.



Refrigerator label



Washing machine label

Energy Efficiency labels

However, the actual amount of electricity used will depend upon how the appliance is used and where it is located. For example, a half-full fridge or freezer uses more energy than a full one; and a cold appliance which is placed next to a heater or oven will use more energy than one that is sited in a cooler place, so kitchen layout is important to energy efficiency.

Some labels now also provide information on other aspects of the performance of the appliance, eg washing performance, water usage per cycle, etc.

Energy Efficiency Recommended

The Energy Saving Trust (EST) manages a labelling scheme for products of proven energy efficiency (eg most white goods, boilers, low-energy lamps, heating controls). These products carry the Energy Efficiency Recommended label. Currently endorsed products can be found at www.saveenergy.co.uk

Ecolabels

There is also a voluntary Ecolabelling scheme that applies to washing machines and some other household goods. Products that display the Ecolabel have passed tests that check key environmental impacts, including energy efficiency. Retailers should be able to provide details of the Energy Labelling and Ecolabelling rating schemes.

Note: the EU energy labelling scheme is currently under review. Possible interim arrangements being considered are A+ and A++ ratings for products that exceed A rated performance. Similarly, technical criteria for EST's Energy Efficiency Recommended scheme is under continuous review. Up to date information on labelling and products can be found at www.mtprog.com,www.saveenergy.co.uk, www.ukepic.com
The energy labelling scheme will change by 2004. The current span of A - G scale will be applied to A - C and the lower grades will be eliminated.

A number of UK and EU searchable technical product information data-bases and buyers-guides are being developed for specifiers, including energy efficiency and wider environmental information. These will be accessible via www.ukepic.com

ALTERNATIVE AND RENEWABLE ENERGY

Introduction

A variety of 'alternative' and renewable energy systems can be used in individual domestic buildings, including:

- Solar energy
- Biofuels
- Geothermal energy.

All of these have the capability to reduce the use of fossil fuels and thus to reduce carbon emissions. Grants and tax credits may be available to promote the use of some alternative and renewable energy technologies.

Solar energy

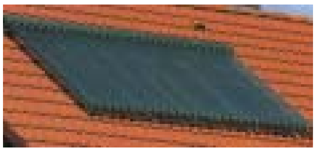
There are three ways in which solar energy may be used in individual domestic buildings: through passive solar design; solar water heating; and solar photovoltaic electricity generation. Active solar thermal space heating systems are not yet cost-effective in the UK.

Passive solar design involves using heat gains from the sun to reduce the heating load of the house. This involves increasing the area of glazing on southerly-facing elevations (±30°) by up to 15%, and reducing the amount of glazing on northerly elevations (±30°) by an equivalent amount, without increasing the overall area of glazing. This increases solar heat gains without increasing overall heat loss. The addition of a southerly-facing unheated conservatory, separated from the house, can also help. The house must be very well-insulated and incorporate materials of high thermal capacity (eg concrete block walls, concrete floors) inside the insulation, in order to absorb solar heat gains at sunny times of day and store them until later, when they are more useful. The house must also have a 'responsive' (ie well-controlled) heating system incorporating room thermostats and/or thermostatic radiator valves (see page 20) so that the heating is reduced or switched off when solar heat gains are available. Good ventilation must be provided (see page 27, 28) to ensure that the house does not overheat in summer. Passive solar design is difficult to apply to existing houses, but is worth considering if the house is already appropriately oriented and a major renovation or extension is being planned.

Active solar water heating involves the use of solar panels to collect energy from the sun and transfer it to the hot water system. Several proprietary systems are available, some of which will provide all the required water heating on sunny, summer days; most systems cannot provide all the water heating in winter, but they will 'pre-heat' the incoming water and thus reduce the load on the boiler or other water heating appliance.

ALTERNATIVE AND RENEWABLE ENERGY

Flat plate collector



Evacuated tube collector

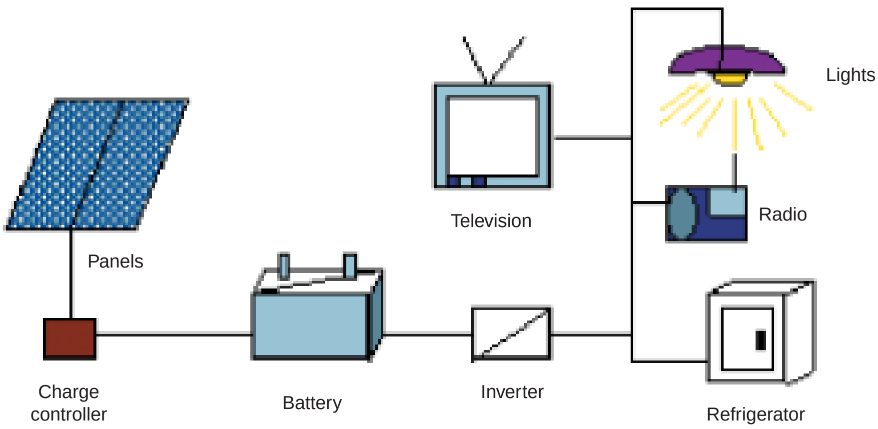
Polycrystalline PVs

C

Two types of solar collector are in common use. A flat plate collector has an absorber (usually a black-painted metal sheet with integral pipes) through which water is circulated by thermosyphoning or by a pump. The front of the absorber is glazed and the rear is insulated. An evacuated tube collector consists of an absorber inside an evacuated glass tube to minimise heat losses without reducing solar transmission. This type of collector is usually more efficient than a flat plate collector, but more expensive. Both types of system can be fitted to existing buildings: the collectors are usually roof-mounted (provided that there is a south-facing pitch (±15°)) and connected to a new hot water storage cylinder incorporating two heat exchange coils (one for the collector and one for the boiler). If the house has a combination boiler a separate pre-heating tank can be installed. An effective system requires between 4 m^2 and 8 m^2 of collector area, depending on the size of the house.

Solar photovoltaic (PV) cells generate electricity from sunlight. There are five main types of cells: monocrystalline silicon (MC); polycrystalline silicon (PC); thin film 'amorphous silicon' (AS); two-layer 'tandem junction' and three-layer 'triple junction' AS cells; and copper indium diselenide (CIS) or cadmium telluride (CdTe) cells. The most efficient types (AS, CIS and CdTe) are also the most expensive, but performance is also influenced by orientation and inclination. PVs of all these types are available in various forms for use in buildings, including: laminated panels; PV roof tiles; sheet metal roofing; and semi-transparent panels. These products may be roof-mounted, or fixed on free-standing frames or pergolas.

The capital cost of solar photovoltaic installations is very high, but falling steadily. In order to satisfy the total electricity demand of a typical house, a large area of PVs is required (about 50% of the roof area), but PVs can be used in conjunction with a mains electricity connection. In this case a 'net metering contract' is advisable, so that surplus electricity (generated on sunny days) may be sold to the electricity supply company at the same price as mains electricity is purchased (on less sunny days).



PV system diagram

ALTERNATIVE AND RENEWABLE ENERGY

Biofuels

Biofuels include a range of storable and transportable solid, granular, gaseous and liquid fuels. These fuels are derived from energy-rich crops, or from processing biologically derived waste products. The most common biofuels are wood chips and wood pellets; others include biogas (predominantly methane) and producer gas (derived from woody materials). There are also various liquid biofuels (eg biodiesel) that are used mainly in vehicles.

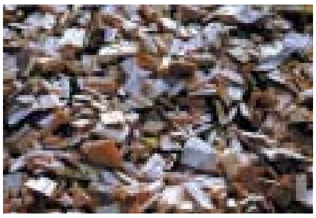
Several wood fuel boilers are available; they use wood chips and/or wood pellets, and can be used for space heating or water heating. Wood chips can be obtained from tree thinnings and prunings, from local woodlands, from wood wastes or from short-rotation coppice (SRC) willow plantations. Wood pellets are commercially available but supplies are limited.

Geothermal energy

Geothermal energy systems make use of heat from underground. They can be used for space heating, water heating and space cooling. The systems have high capital costs, low running costs and can provide appropriate alternatives to mains electricity in areas where there are no gas supplies.

Heat is usually extracted from the ground using an electric heat pump; if the heat pump is powered by electricity from a renewable source (eg wind power or PVs) then the carbon emissions associated with the use of the systems can be reduced to zero.

The most common geothermal energy system for domestic use is the ground source heat pump (GSHP). Liquid is pumped through a ‘ground loop’ of pipework that is either laid across an area of ground (a few centimetres beneath the surface) or is inserted into a vertical borehole up to 50 m deep. The liquid absorbs heat from the ground and the heat pump then extracts this heat and delivers it via a heat exchanger to a conventional heat distribution or hot water system. Some systems allow the heat pump to be reversed in order to provide summer cooling. Ground source heat pumps work best with under-floor heating systems in which the heat distribution coils are laid in concrete floor slabs. The concrete absorbs and re-emits the heat, evening out the heat distribution. Several commercial GSHPs are available; they should be considered as an alternative to electric heating when a heating system is being completely replaced, as part of a major refurbishment, in areas without mains gas supplies.



Wood chips

Wood pellets

C

Ground source heat recovery

Horizontal loop

Vertical loop

Ponds

ENVIRONMENTAL STATEMENT

There is growing global pressure to ensure that construction materials are sustainable. Whilst energy efficiency initiatives over the last 30 years have reduced the energy needed to heat a typical house considerably, initiatives to reduce the impact from construction materials have been comparatively slow.

The Green Guide to Housing Specification (Anderson and Howard, BRE, 2000 – see page 38) provides a useful reference for construction products, giving A,B,C environmental ratings for over 250 specifications. This definitive guide, developed over 20 years and supported in its current form by the National House-Building Council (NHBC), is predominantly based on life cycle assessment data from the DETR-supported BRE Environmental Profiles scheme. The Guide contains an extensive list of references to all of its sources of data.

The use of insulation in the building fabric will significantly reduce the operational environmental impact of the building over its lifetime. This benefit will outweigh the embodied environmental impact of the insulation materials. To minimise the embodied impact however, specifiers should avoid foam insulation materials that use blowing agents which cause ozone depletion or global warming, such as HCFCs or HFCs. Alternative blowing agents such as carbon dioxide or pentane are less environmentally damaging.

For best overall environmental performance, look to renewable or recycled materials such as cork, recycled cellulose, flax or sheep's wool, foams blown using pentane or CO_2 and low density mineral wool or glass wool, all of which have high ratings in the Green Guide to Housing Specification and have similar insulation properties to mineral wool and expanded polystyrene. Lower density glass and mineral wools should be used in preference to denser ones where possible, as their environmental impact increases proportionally with their weight.

Despite their comparatively low mass, windows and doors typically contribute between 5 and 10% of the embodied environmental impact of a house.

As rated by the Green Guide to Housing Specification, PVC-U has a poor environmental rating due to the high energy intensity of the materials' manufacture and the fact that they have no recycled input; however the industry is taking steps to encourage the recycling of PVC-U.

Primary aluminium manufacture is also very energy intensive though much less energy is needed to process recycled aluminium. But although aluminium extrusions contain around 30% recycled aluminium, and are also extensively recycled, the high impacts from primary and secondary aluminium manufacture still result in high overall environmental impact for aluminium windows.

Softwood timber windows, made from renewable material requiring low energy in manufacture, perform well. As with all timber products, specifiers should ensure that the timber is sustainably grown. This is particularly relevant for tropical hardwood windows, which also involve much longer transport distances. Locally grown hardwoods will have similar impacts to softwood. Information on sustainably sourced timber is available from the Forest Stewardship Council www.fsc-uk.demon.co.uk, Tel 01686 413916.

GRANTS, ASSISTANCE

GRANTS

Warm Front (England), Warm Deal (Scotland), Warm Homes (Northern Ireland) and Home Energy Efficiency Scheme (Wales) are government-funded schemes that provide insulation, draught stripping, heating improvements and in some cases new heating systems for low-income households that are in receipt of qualifying benefits.

- Warm Front (England) tel 0800 316 6011
- Warm Deal (Scotland) tel 0800 0720150
- Warm Homes (Northern Ireland) tel 0800 181667
- Home Energy Efficiency Scheme (Wales) New HEES and HEES Plus tel 0800 3162815

The Energy Saving Trust

The Energy Saving Trust (EST) runs a number of grant schemes and manages a network of local Energy Efficiency Advice Centres (EEACs). For information on current schemes visit the grant information database via www.saveenergy.co.uk For details of your local EEAC tel 0800 512012

Fuel industries

The fuel industries offer grants under the Energy Efficiency Commitment (www.saveenergy.co.uk). Information about most of the approved schemes can be obtained by contacting the local energy advice centre (0800 512 012). Alternatively, contact your electricity or gas supplier.

Local authorities

Local authorities offer Renovation Grants and Improvement Grants. Contact your local council for details.

ASSISTANCE

Energy efficiency advice

- The Energy Saving Trust. The EST manages a UK wide network of Energy Efficiency Advice Centres (EEACs). Telephone 0800 512012 and you will be automatically connected to the EEAC that covers your area – www.saveenergy.co.uk

Insulation and draught-stripping

- Eurisol (UK Mineral Wool Association) tel 01525 385886 www.eurisol.com
- CIGA (Cavity Insulation Guarantee Agency) tel 01525 853300 www.ciga.co.uk Both at CIGA House, 3 Vimy Court, Vimy Road, Leighton Buzzard, Beds LU7 1FG
- National Cavity Insulation Association Insulated Render and Cladding Association Draught Proofing Advisory Association All at PO Box 12, Haslemere, Surrey GU27 3AH, tel 01428 654011
- Cavity Foam Bureau, PO Box 79, Oldbury West Midlands B69 4PG, tel 0121 544 4949
- External Wall Insulation Association PO Box 12, Haslemere, Surrey GU27 3AH, tel 01428 654011

Heating Systems and Controls

- CHIC (Central Heating Information Council) 36 Holly Walk, Leamington Spa, Warwickshire CV32 4LY, tel 0845 600 2200, www.centralheating.co.uk
- CORGI (Council of Registered Gas Installers) 1 Elmwood, Chineham Business Park, Basingstoke RG24 8WG, tel 01256 372200 www.corgi-gas.com
- HVCA (Heating and Ventilating Contractors' Association) ESCA House, 34 Palace Court London W2 4JG, tel 020 7313 4900 www.hvca.org.uk
- IDHE (Institute of Domestic Heating and Environmental Engineers) Dorchester House, Wimblestraw Road, Berinsfield, Wallingford OX10 7LZ, tel 01865 343096, www.idhe.org.uk
- The Institute of Plumbing, 64 Station Lane, Hornchurch, Essex RM12 6NB, tel 01708 472791 www.plumbers.org.uk
- OFTEC (Oil-Firing Technical Association) Century House, 100 High Street, Banstead Surrey SM7 2NN, tel 0845 6585080 www.oftec.org.uk
- Scottish and Northern Ireland Plumbing Employers Federation, 2 Walker Street Edinburgh EH3 7LB, tel 0131 225 2255
- TACMA (The Association of Control Manufacturers), Westminster Tower 3 Albert Embankment, London SE1 7SL tel 020 7793 3008 www.heatingcontrols.org.uk
- Waterheater Manufacturers Association New Design, Wednesbury One, Black Country New Road, Wednesbury WS10 7NZ www.waterheating.fsnet.co.uk
- Heating Efficiency Testing and Advisory Service Ltd (HETAS Ltd) PO Box 37, Bishops Cleeve, Cheltenham GL52 9TB, tel 01242 673257

Glazing

- Glass and Glazing Federation (administers the FENSA scheme in England and Wales) 44-48 Borough High Street, London SE1 1XB, telephone 020 7403 7177, www.ggf.org.uk

FURTHER GUIDANCE

Further guidance about heating and hot water systems appears in *The Domestic Heating and Hot Water Guide to the Building Regulations 2001 Part L1*, published by the Energy Efficiency Partnership for Homes (applies to England and Wales only). To obtain a copy call 0845 727 7200 or visit the Central Heating Information Council's website at www.centralheating.co.uk

Authenticated seasonal efficiencies for most boilers appear in the Boiler Efficiency Database at www.boilers.org.uk and in The Little Blue Book of Boilers. Copies of the book can be obtained by calling the Energy Saving Trust's Efficiency Hotline (0845 727 7200) or via your local Energy Efficiency Advice Centre (0800 512 012).

BRE

Available from www.brebookshop.com
email brebookshop@emap.com
Tel: 01923 664262

- BR 390: The Green Guide to Housing Specification

BRITISH BOARD OF AGRÉMENT

P0 Box 195, Bucknalls Lane, Garston
Watford WD25 9BA
Tel: 01923 665 300
www.bbacerts.co.uk
BBA publishes a monthly directory which includes a list of approved cavity insulation installers

BRITISH STANDARDS INSTITUTION

389 Chiswick High Road, London W4 4AL.
Tel: 020 8996 9000, web: www.bsi.global.com

British Standards (BSI)

To order BSI standards telephone 020 8996 9001.

BS 5803: 1985 Parts 1-5 Thermal insulation for use in pitched roof spaces.

BS 1566: 2002 Parts 1-2 Copper indirect cylinders for domestic purposes.

BS 5615: 1985 Specification for insulating jackets for hot water storage cylinders.

THE STATIONERY OFFICE

The Stationery Office, London
Tel: 0870 600 5522, web: www.tso.co.uk

Regulations (National Details)

These documents can be obtained from The Stationery Office, London www.tso.co.uk/bookshop.

- The Building Regulations 2000 (England and Wales) Part L1 are set out in *The Building Regulations 2000, Approved Document L1 Conservation of Fuel and Power*
- The relevant Building Standards for Scotland are set out in *The Building Standards (Scotland) Regulations 1990, 6th amendment, Technical standards to Part J, Conservation of Fuel and Power*
- The relevant Building Standards for Northern Ireland are set out in *Building Regulations (Northern Ireland) Part F Conservation of Fuel and Power*

D

‘Cost Benefit’ Tables (GPG 171CE)

Detached house, or bungalow	Saving (£/yr)	Installed Cost (£)	Payback (yrs)	DIY COST (£)	Payback (yrs)
Cavity Wall Insulation	£115 – £145	£360 – £550	2 – 5		
Solid Wall Insulation (external)	£220 – £250	Approx £2300 (Marginal)	9 – 10		
Solid Wall Insulation (internal)	£220 – £250	£37/sq m		£15/sq m	
Roof Insulation (new installation)	£100 – £120	£260 – £360	2 – 4	From £220	Around 2 Years
Roof Insulation (top up)	£25 – £35	£230 – £310	7 – 12	From £170	6 – 9
Floor Insulation	£25 – £35		–	From £100	3 – 4
Replacement Condensing Boiler	£40 – £50	From £150	3 – 4		
Hot Water Insulation Package	£10 – £20			From £20	1 – 2
Full Heating Controls Package	£70 – £80	£125 – £250	2 – 4		
Draught-stripping	£10 – £15	£125 – £150	8 – 15	From £40	3 – 4
Lighting (4 x Lamps)	Approx £20			Approx £20	1 Year

Semi-detached/End-of-Terrace	Saving (£/yr)	Installed Cost (£)	Payback (yrs)	DIY COST (£)	Payback (yrs)
Cavity Wall Insulation	£70 – £100	£260 – £380	3 – 5		
Solid Wall Insulation (external)	£140 – £170	Approx £1500 (Marginal)	9 – 11		
Solid Wall Insulation (internal)	£140 – £170	£37/sq m		£15 sq m	
Roof Insulation (new installation)	£80 – £100	£220 – £250	2 – 3	From £170	Around 2 Years
Roof Insulation (top up)	£20 – £30	£200 – £230	7 – 12	From £140	5 – 7
Floor Insulation	£15 – £25			From £100	4 – 7
Replacement Condensing Boiler	£30 – £40	From £150	4 – 5		
Hot Water Insulation Package	£10 – £20			From £20	1 – 2
Full Heating Controls Package	£50 – £60	£125 – £250	2 – 5		
Draught-stripping	£10 – £15	£85 – £110	6 – 11	From £40	3 – 4
Lighting (4 x Lamps)	Approx £20			Approx £20	1 Year

The figures in this table are only an indication of costs; actual quotations could be higher or lower.

NOTES

- The costs and savings figures will vary according to the size of the house, its location, the measure (if appropriate), fuel, heating system and the materials used.
- Energy savings are estimated from a range of standard house types with gas heating and a standard occupancy. Actual savings depend on individual circumstances. Remember that some of the benefit may be taken in improved comfort.
- DIY costs are for these measures where an average level of DIY skill is required. If in doubt about any aspect of the installation skills required consult an appropriately qualified person.

The installed costs per measure are a range where the lower cost is intended to be representative of the typical cost to the householder in a subsidised scheme eg Energy Efficiency Commitment (EEC).

Lighting savings assume a mixture of wattages replaced and hours of use.
DIY Cost of Floor insulation assumes the material cost of the insulant required.

Costs and savings given for condensing boilers are marginal, ie the difference between installing an 88% efficient condensing boiler rather than a 78% efficient non-condensing boiler. Allowances or grant aided or subsidised schemes for boilers has not been taken into account as these can vary significantly.

This leaflet should be used with the GPG 171 *Domestic Energy Efficiency Primer,* Housing Energy Efficiency Best Practice programme (HEEBPp) Helpline tel 01923 664258. Website www.housingenergy.org.uk

'Cost Benefit' Tables (GPG 171CE)

Mid-Terraced	Saving (£/yr)	Installed Cost (£)	Payback (yrs)	DIY COST (£)	Payback (yrs)
Cavity Wall Insulation	£40 – £70	£210 – £300	3 – 8		
Solid Wall Insulation (external)	£70 – £100	Approx £800 (Marginal)	8 – 11		
Solid Wall Insulation (internal)	£70 – £100	£37/sq m 9		£15/sq m	
Roof Insulation (new installation)	£80 – £100	£210 – £240	2 – 3	From £170	Around 2 Years
Roof Insulation (top up)	£20 – £30	£190 – £220	6 – 11	From £130	6 – 9
Floor Insulation	£15 – £25			From £70	3 – 5
Replacement Condensing Boiler	£20 – £30	From £150	5 – 8		
Hot Water Insulation Package	£10 – £20			From £20	1 – 2
Full Heating Controls Package	£40 – £50	£125 – £250	3 – 6		
Draught-stripping	£10 – £15	£85 – £110	6 – 11	From £40	3 – 4
Lighting (4 x Lamps)	Approx £20			Approx £20	1 Year

Flat	Saving (£/yr)	Installed Cost (£)	Payback (yrs)	DIY COST (£)	Payback (yrs)
Cavity Wall Insulation	£30 – £40	£170 – £265	4 – 9		
Solid Wall Insulation (external)					
Solid Wall Insulation (internal)	£60 – £70	£37/sq m		£15/sq m	
Roof Insulation (new installation)	£130 – £150	£225 – £250	Around 2 Years	Around £250	Around 2 Years
Roof Insulation (top up)	£30 – £40	£200 – £230	5 – 8	From £200	5 – 7
Floor Insulation	£10 – £20			From £100	5 –10
Replacement Condensing Boiler	Approx £20	From £150	Around 8	–	–
Hot Water Insulation Package	£10 – £20			From £20	1 – 2
Full Heating Controls Package	£30 – £40	£125 – £250	3 – 8	–	–
Draught-stripping	£5 – £10	£40 – £60	4 – 12	From £40	4 – 8
Lighting (4 x Lamps)	Approx £20			Approx £20	1 Year

The figures in this table are only an indication of costs; actual quotations could be higher or lower.

NOTES

- The costs and savings figures will vary according to the size of the house, its location, the measure (if appropriate), fuel, heating system and the materials used.
- Energy savings are estimated from a range of standard house types with gas heating and a standard occupancy. Actual savings depend on individual circumstances. Remember that some of the benefit may be taken in improved comfort.
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Cost Benefit Tables

If this insert is missing please ring the HEEBPp Helpline **01923 664258** for a copy, or see

www.housingenergy.org.uk

Publications

HEEBPp Publications

The Housing Energy Efficiency Best Practice programme (HEEBPp) offers a wide range of free publications about energy efficient best practice in housing. To order individual copies, a publications list or obtain further information contact the HEEBPp Helpline on 01923 664258 or visit the website at www.housingenergy.org.uk

The following HEEBPp publications have been referred to in this Guide:

Good Practice Guides (GPG)

GPG 26: Cavity wall insulation in existing housing

GPG 138: Internal wall insulation in existing housing

GPG 155: Energy efficient refurbishment of existing housing

GPG 284: Domestic central heating and hot water systems with gas- and oil-fired boilers

GPG 294: Refurbishment site guidance for solid-walled houses – ground floors

GPG 295: Refurbishment site guidance for solid-walled houses – windows and doors

GPG 296: Refurbishment site guidance for solid-walled houses – roofs

GPG 297: Refurbishment site guidance for solid-walled houses – walls

GPG 301: Domestic heating and hot water systems

GPG 302: Controls for domestic central heating and hot water: guidance for specifiers and installers

General Information Leaflet (GIL)

GIL 20: (2002) Low energy domestic lighting – a summary guide

GIL 23: Cavity Wall insulation – unlocking the potential in existing dwellings

GIL 59: Central Heating System Specifications (CHeSS) Year 2002

GIL 70: The effect of Building Regulations (Part L1 2002) on existing dwellings (England and Wales)

GIL 74: Domestic Condensing Boilers – the benefits and the myths

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Energy Efficiency Best Practice in Housing

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